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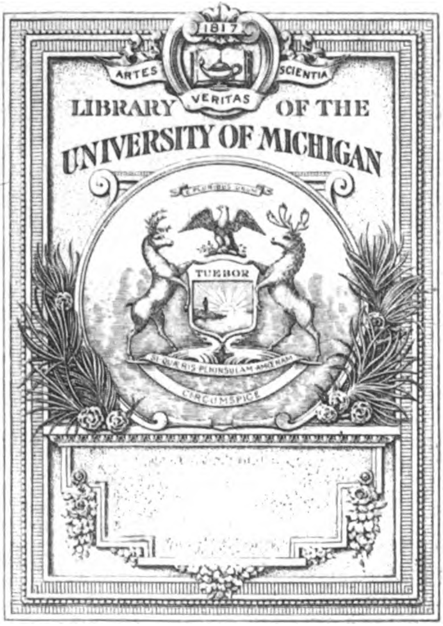
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U. S. Bureau of reclamation.

DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

FIFTEENTH ANNUAL REPORT

OF THE

RECLAMATION SERVICE

1915–1916

A. P. DAVIS, Director and Chief Engineer
WILL R. KING, Chief Counsel
W. A. RYAN, Comptroller

WASHINGTON
GOVERNMENT PRINTING OFFICE
1916

ANNUAL REPORTS OF THE RECLAMATION SERVICE.

[Reports may be purchased from superintendent of documents, Government Printing Office, at the prices given.]

I. June 17 to Dec. 1, 1902; 317 pages, 46 plates, 65 figures, case of drawings. Out of print.
II. Through the field season of 1903; 550 pages, 49 plates, 56 figures. Cloth, 85 cents.
III. Through the field season of 1904; 653 pages, 59 plates, case of drawings. Cloth, $1.25.
IV. Through the field season of 1905; 374 pages, 63 plates. Paper, 80 cents.
V. Fiscal year 1905–6; 312 pages, 101 plates, 2 figures. Cloth, $1.25.
VI. Fiscal year 1906–7; 287 pages. Paper, 25 cents.
VII. Fiscal year 1907–8; 219 pages. Paper, 25 cents.
VIII. Fiscal year 1908–9; 222 pages. Cloth, 40 cents; paper, 20 cents.
IX. Fiscal year 1909–10; 329 pages. (Includes history of construction to date.) Cloth, 40 cents; paper, 25 cents.
X. Fiscal year 1910–11; 290 pages. (Includes index Vols. I–X.) Cloth, 40 cents; paper, 25 cents.
XI. Fiscal year 1911–12; 310 pages, map. Cloth, 40 cents; paper, 25 cents.
XII. Fiscal year 1912–13; 382 pages. Cloth, 40 cents; paper, 25 cents.
XIII. Fiscal year 1913–14; 514 pages. Cloth, 45 cents; paper, 30 cents.
XIV. Fiscal year 1914–15; 521 pages. Cloth, 45 cents; paper, 30 cents.
XV. Fiscal year 1915–16; 808 pages. Cloth, 75 cents; paper, 60 cents.

A price list of publications issued by the Reclamation Service can be obtained by application to the Director and Chief Engineer, United States Reclamation Service, Washington, D. C.

The monthly bulletin of the service, the "Reclamation Record," is issued about the first of each month. It contains 40 or more pages of general news and notes of interest about the projects. The subscription price is 50 cents per year.

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LETTERS OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
Washington, December 4, 1916.

SIR: In compliance with the provisions of section 2 of the act approved June 17, 1902, entitled "An act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," I have the honor to transmit the Fifteenth Annual Report of the Reclamation Service.

Respectively,

FRANKLIN K. LANE, *Secretary.*

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

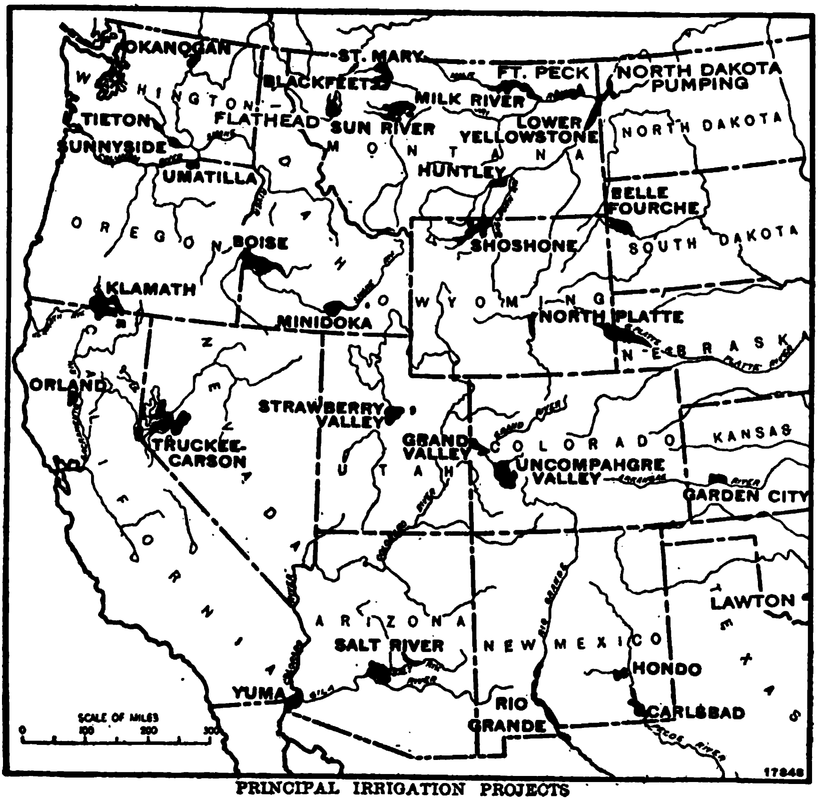
DEPARTMENT OF THE INTERIOR,
UNITED STATES RECLAMATION SERVICE,
Washington, D. C., September 11, 1916.

SIR: Transmitted herewith is the Fifteenth Annual Report of the Reclamation Service. This report relates in particular to the work completed and in progress during the fiscal year ended June 30, 1916, but in addition contains a brief history of construction and engineering features from the beginning of the work, in order that the methods, progress, and results of reclamation work may be more readily understood.

Very respectfully,

A. P. DAVIS,
Director and Chief Engineer.

The SECRETARY OF THE INTERIOR.



PRINCIPAL IRRIGATION PROJECTS
IN THE WESTERN UNITED STATES

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FIFTEENTH ANNUAL REPORT

OF THE

RECLAMATION SERVICE.

GENERAL DISCUSSION.

DEVELOPMENT OF RECLAMATION PROJECTS.

During the past year the operation of the reclamation laws has continued to advance their objects as shown by the increase in the area for which the service could supply water, the increase in the areas actually irrigated and cropped, the increase in the value of crops produced, and the increase in the actual number of settlers and of homes. The progressive increase in these elements is shown in the following table:

Results of reclamation.[1]

Year.	Irrigable acreage.[2]	Irrigated acreage.	Irrigated farms.	Cropped acreage.	Crop value.
1909	730,000	382,000	9,000	....	....
1910	880,000	475,000	12,000	415,000	$12,500,000
1911	1,015,000	560,000	14,000	470,000	13,000.000
1912	1,160,000	645,000	15,000	590,000	14,500,000
1913	1,200,000	700,000	16,000	650,000	16,000,000
1914	1,250,000	770,000	18,000	700,000	16,500,000
1915	1,500,000	857,000	20,000	800,000	19,000,000

[1] Exclusive of Indian projects built for Indian Service.

[2] Area Reclamation Service was prepared to supply water.

PRINCIPAL CONSTRUCTION RESULTS DURING YEAR.

No new projects have actually been taken up within the fiscal year and none will be without express authority from Congress.

The Salt River project has been completed and is ready for issue of public notice. Some damage was caused by floods in January, 1916, which has mostly been repaired. The power development incident to this project has resulted in the delivery of large quantities of power for mining and other industrial and domestic uses, yielding large monthly revenues.

On the Yuma project, the distribution system of the Yuma Valley has been extended to additional lands and this is practically completed. Water is now available for all the irrigable lands in the valley south of Yuma. Progress has been made in the revetment of levees with rock to protect this valley from the incursions of the river. Nearly half of the irrigable land on the California side, amounting to about 3,000 acres, is injured by seepage, and requires drainage, which has not been authorized by the entrymen.

The construction of the Orland project has been practically completed with the exception of some provision for the care of storm water and waste water. The project has been opened by public notice and construction payments will begin October 1, 1916.

The construction of the Grand Valley project is under way. The completed portion of the main canal is being tested and primed and some water can be delivered during 1917 on a rental basis. The main canal in places passes through deep cuts in shale which have developed crevices allowing seepage from the canal to the injury of lands below. This is being corrected by puddling such places with clay and other suitable material obtainable in the vicinity.

The Uncompahgre Valley project is approaching completion, the work during the past year comprising the operation of completed works under the laterals constructed and the enlargement and extension of the Ironstone Canal and construction of laterals therefrom to cover new land.

On the Boise project, the Arrowrock Dam has been completed, furnishing storage on the Boise River to the amount of 250,000 acre-feet and regulating the flow at all times for diversion by the main canal below either for irrigation direct or for storage in the Deer Flat Reservoir. The water supply as thus regulated is capable of supplying from 20,000 to 30,000 acres of land not yet reached by canals. Surveys are in progress to determine where this can best be used, as there are possibilities on both the north side and the south side of the river. The land under canals, amounting to 230,000 acres, is being served on a rental basis and is ready for opening under public notice at an early date.

On the Minidoka project, the gravity portion has been under public notice for some years and public notice has been issued recently for the pumping portion. The gravity portion recently voted by a large majority to take over the operation and maintenance of the system, and contract to this effect has been entered into under the provisions of the reclamation extension act.

The enlargement of Jackson Lake Reservoir under contract with the Kuhn Irrigation & Canal Co. and the Twin Falls Canal Co., by which these companies will be provided with about 400,000 acre-feet of storage capacity, is nearly completed. The funds for this work were advanced by the above-named companies.

On the Huntley project drainage work is under way and has been successful in relieving the waterlogged lands in the vicinity of the drains.

Construction on the Milk River project has been prosecuted actively during the year. The feed canal from St. Mary River to the Milk River has been completed and is being seasoned ready for use in 1917. Work is under way on the Sherburne Lakes storage dam, and the diversion of Swift Current Creek into St. Mary Lake has been accomplished. The Vandalia Diversion Dam has been completed with the exception of the movable crest, and water is being delivered therefrom. The development of Nelson Reservoir has been completed and water is being carried into that reservoir by the Dodson South Canal.

Construction is actively in progress on the Sun River project, the main diversion dam has been completed, and the main canal is well advanced toward completion. Work is now in progress on the distribution systems.

Construction work is being pushed actively on the Fort Laramie unit of the North Platte project, which will take water from the south end of the Whalen Diversion Dam, opposite the head of the Interstate Canal.

On the Truckee-Carson project the possession of the outlet works at Lake Tahoe has been secured and water has been stored to the level indicated in the compromise agreement proposed by Messrs. O'Shaughnessy and Maltby.

On the Carlsbad project the floods of 1915 did considerable damage to the spillways of the McMillan Reservoir which required repairs. The water users have voted by a large majority to include this expense as a charge against the project and repairs are now under way.

On the Rio Grande project, construction is being pushed actively on the canal systems west of the river. The Mesilla Diversion Dam has been completed, and work is being started on the Percha Diversion Dam for the Rincon Valley.

On the North Dakota pumping project power is being delivered under contract to the city of Williston, but the landowners were unable to meet the conditions imposed by law that they should defray the entire cost of the operation of the pumping system, and that system was not operated during 1916.

Negotiations and various arrangements for beginning work on the Lawton project, Oklahoma, which has been authorized by Congress, have been in progress. The difficulty has been to secure a sufficiently compact area to permit economical irrigation owing to the reluctance of some of the landowners to subdivide and sell their holdings in the manner required by section 12 of the reclamation extension act.

On the Umatilla project construction has been pushed actively on the west extension for which the diversion dam and main canal have been completed. The entire canal system will be lined with concrete, and this is well advanced. Water is being delivered on a rental basis to a small area of land.

On the Klamath project sublaterals have been built to certain areas in the uncovered Tule Lake bed, and surveys have been made looking to the possible development of the Pine Grove and Sand Hollow units in cooperation with the landowners thereof.

On the Yakima project construction has been pushed on the Keechelus Dam, and this is nearly completed. Pumping plants have been built for the Outlook and Snipes Mountain irrigation districts. Contracts have been awarded for certain portions of the Grandview irrigation unit.

On the Shoshone project construction has been pushed on the development of additional lands in the Frannie unit. Water will be delivered to a considerable area therein in 1917. Settlement on this project has been rapid and satisfactory during the past year.

SUMMARY OF CONSTRUCTION RESULTS.

The following table gives in concise form many of the items which have been accomplished. A more detailed table, by projects, will be found in the appendix:

Summary of construction results, June 30, 1916.

LANDS.

Items.	To June 30, 1916.		To June 30, 1915.		Increase.	
	Acres.	*Farms.*	*Acres.*	*Farms.*	*Acres.*	*Farms.*
Estimated area of projects on completion	3,117,862	60,367	3,118,011	60,603	[1] −149	[1] −236
Estimated area to which service was prepared to supply water	1,690,244	34,826	1,450,407	29,017	239,837	5,809
Under contract:						
Water rights	542,960	11,536	461,632	10,122	81,328	1,414
Rental contracts, etc	764,743	15,882	626,371	13,008	138,372	2,874
Total	1,307,703	27,418	1,088,003	23,130	219,700	4,288
Reservoir capacity available, acre-feet.	9,035,160	....	6,500,360	....	2,534,800	....

[1] Reduction due to revision of estimates.

CANALS, DITCHES, AND DRAINS.

Item.	To June 30, 1916.	To June 30, 1915.	Increase.
	Miles.	*Miles.*	*Miles.*
Canals over 800 second-feet capacity	382	359	23
Canals 301 to 800 second-feet capacity	664	610	54
Canals 50 to 300 second-feet capacity	1,580	1,420	160
Canals less than 50 second-feet capacity	6,891	6,371	520
Total canals	9,517	8,760	757
Ditches and open drains	914	832	82
Grand total canals, ditches, and open drains	10,431	9,592	839

TUNNELS.

Number	[2] 89	89	....
Length .... feet	133,333	133,300	33

[2] Arrowrock Tunnel closed, but included here.

DAMS: STORAGE AND DIVERSION.

	Number.	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*
Masonry	42	2,071,372	1,992,502	78,870
Earth	39	9,684,493	9,231,109	453,384
Rock fill and crib	19	984,138	978,474	5,664
Total	100	12,740,003	12,202,085	537,918

DIKES AND LEVEES.

Items.	To June 30, 1916.		To June 30, 1915.		Increase.	
	Miles.	*Cu. yds.*	*Miles.*	*Cu. yds.*	*Miles.*	*Cu. yds.*
Mileage and volume	92.8	4,190,106	90.6	4,076,766	2.2	113,340

Summary of construction results, June 30, 1916—Continued.

CANAL STRUCTURES.

	Concrete.	Wood.	Concrete.	Wood.	Concrete.	Wood.
Costing over $2,000 ....number..	838	129	730	107	108	22
Costing $500 to $2,000 ....do....	1,633	395	1,482	323	151	72
Costing $100 to $500 ....do....	7,197	4,383	6,696	4,129	501	254
Costing less than $100 ....do....	9,980	48,008	7,226	44,154	2,754	3,854
Total	[1] 19,648	52,915	16,134	48,713	[1] 3,514	4,202

[1] Includes 521 structures costing from less than $100 to $500 each.

BRIDGES.

	Number.	Length.	Number.	Length.	Number.	Length.
		Feet.		*Feet.*		*Feet.*
Steel	98	6,325	85	5,433	13	892
Combination	389	11,439	240	7,311	149	4,128
Wood	4,397	94,736	4,013	85,922	384	8,814
Concrete	300	3,899	284	3,740	16	159
Total	5,184	116,399	4,622	102,406	562	13,993

CULVERTS.

		Feet.		*Feet.*		*Feet.*
Concrete	1,381	68,745	1,273	61,112	108	7,633
Metal	1,270	44,437	1,146	40,119	124	4,318
Terra cotta	796	36,596	567	29,052	229	7,544
Wood	2,979	67,147	2,728	62,663	251	4,484
Total	6,426	216,925	5,714	192,946	712	23,979

PIPE.

	Feet.	*Feet.*	*Feet.*
Concrete	520,447	486,635	33,812
Metal	215,791	193,541	22,250
Terra cotta (tile)	857,103	634,108	222,995
Wood	280,270	260,676	19,594
Total	1,873,611	1,574,960	298,651

FLUMES.

	Number.	Length.	Number.	Length.	Number.	Length
		Feet.		*Feet.*		*Feet.*
Concrete	69	11,544	33	4,189	36	7,355
Metal	483	123,248	407	112,533	76	10,715
Wood	1,618	353,932	1,461	335,324	157	18,608
Total	2,170	488,724	1,901	452,046	269	36,678

CANALS LINED.

	Miles.	*Miles.*	*Miles.*
Concrete	241.0	140.5	100.5
Wood	3.9	3.0	.9

SECONDARY PROJECTS.

The appropriation for secondary projects was allotted largely to the investigations in various parts of the Colorado River Basin to establish a proper policy for the United States in connection with both interstate and international interests concerning the waters of this basin.

About two-thirds of the appropriation was used for this purpose and part was required for finishing cooperative work on the investigation of California projects in the Sacramento Basin and on cooperative work in Oregon. Investigations were also made of the feasibility of pumping from the North Platte River in Wyoming, and report thereon was prepared. Reports were also prepared on the Turkey Creek project, a private enterprise in Oklahoma which had been destroyed by flood, and upon the Pecos River Valley in Texas.

RECLAMATION LAWS AND THEIR RESULTS.

The reclamation laws, including the act of 1902, and various later acts amendatory thereof and supplementary thereto, have for their object the creation of a maximum number of prosperous homes in the arid regions of the United States. This is shown by the liberal terms of payment without interest, the limitation of the holdings of private land which may acquire a water right under those laws, and the limitation of homesteads on public lands to the area reasonably necessary to support a family.

The latter limitation and the residence requirement, as well as the liberal terms, all indicate conclusively that secondary to the creation of homes the intent was to provide homes for the homeless.

Some cases have occurred where men of little capital and no experience have settled on reclamation projects and by their perseverance and ability combined with favorable conditions have succeeded in building up homes worth thousands of dollars while some of their neighbors similarly situated, who began with considerable capital and perhaps greater experience, have not achieved equal success.

The cases of success with little capital, however, are relatively few and are likely to be misleading if often quoted. In general, the settler should have from one to three thousand dollars in order to develop a homestead of 40 acres promptly and economically, and for larger homesteads larger capital is necessary for the best results. Care, skill, industry and perseverance are all equally as necessary as capital and without these or any one of these, failure is almost certain; and it may be set down as one of the achievements of the reclamation legislation that in addition to the reclamation of the land, the creation of homes, and the betterment of the material condition of a large number of deserving citizens, the process has developed mental and moral qualities of even greater benefit to the Nation.

In general, it may be said that the material values created by the construction of irrigation works under the reclamation law have been far greater than and in some cases several times the amount expended upon the works. These values are reflected almost entirely in the rise in value of land, and if this increase of land value, or any large fraction of it could be promptly returned to the Government through any legal process, it would afford a large profit on the investment.

That the benefits of the Government construction would incidentally accrue to private landholders was recognized by Congress when it prohibited the sale of water rights to a larger area than 160 acres in one holding, and this was evidently an effort to prevent the acquisition of an unfair proportion of the benefits by one landholder.

The provision, however, has no effect on the distribution of the benefits to towns and cities in the vicinity whose business has been largely increased by the construction of the irrigation project, resulting often in doubling or trebling land values in those cities in a very short time. The reclamation law affords no means of recovering those values to the reclamation fund. Section 12 of the reclamation extension act sought to strengthen the hands of the Government by requiring that private holdings in excess of 160 acres in new projects shall be subdivided and sold at such a price as the Secretary of the Interior may designate, and if not so subdivided shall be excluded from the project. This provision affords little relief, as it can not be applied to projects already taken up; and wherever applied, though it may limit the price at which the present holder can sell his land, the purchaser who buys from him may sell to the actual settler at such price as he is able to extort. It may result in the introduction of a middleman without protecting the actual settler. The exclusion of the land, however, does not prevent the landowner from holding it at a price that discounts the added value conferred by prospective water rights, for the logic of the situation enables him to convince the purchaser that once the land is in the hands of a small holder the law would not prevent the purchase of water right, and the economy of so including the area within the project would induce the Government to sell him such a water right.

A more effective means of compelling large landholders to bear their just proportion of the cost of the project is made available by the passage in various States of laws providing for the formation of irrigation districts. Under such laws it is generally possible, where a majority of the landowners desire to provide funds for irrigation works, to force the minority to assume their fair share of the burden through the medium of taxation.

DIFFICULTIES OF THE SETTLERS.

Practically every annual report of this service has stated that the principal difficulty with which the average settler on the reclamation projects has to contend is the lack of sufficient capital. In some cases the settler may originally have had considerable capital, but his lack of experience, or other misfortune, has operated to his disadvantage until his funds have been practically exhausted, and after he has acquired the necessary experience he is often unable to recover his standing for the lack of the necessary capital.

This lack of capital is felt more acutely the larger the area acquired or attempted to be cultivated. The instances of success with small capital especially in the case of inexperienced settlers are confined almost entirely to small holdings of 40 acres or less, and perhaps no one circumstance has operated so strongly to handicap settlers in making a success upon Government projects as the attempt to hold and improve too much land.

The Huntley project in Montana is conspicuously successful as far as individual prosperity is concerned. This project was handicapped by the cold climate, the usual drawbacks of refractory soil, and the characteristic desert difficulties, but it was opened under a special law which gave the Secretary wide discretion, and policies were adopted which could not be applied to other projects owing to legal requirements. The size of the farm unit was in general made 40 acres. Settlers were not permitted upon the land until the water was ready for delivery, and when settlement was invited, each settler was obliged to pay $1 per acre to the Indian tribe as partial payment for the land and also ten per cent of the water charge at time of entry.

These substantial payments eliminated the impecunious speculator; the settler was not compelled to live for years upon an arid homestead without water and thus dissipate his means and his patience, and he was not permitted to take more land than was necessary for his livelihood. Thus were eliminated the three principal causes of failure upon other projects.

The Shoshone project and many other projects illustrate strikingly the contrast between large and small holdings. On those projects, homesteads near railroad stations are generally made 40 acres while farther out they contain 80 acres of irrigable land and sometimes more, up to a limit of 160 acres. In general, the individuals with the small holdings having less tax upon their resources for improvements and water charges, have been successful, while their neighbors similarly situated, but with larger holdings, have been unable with their means to cultivate any larger area of land during the first few years when the struggle is on, and have had the additional burden of double the water charges and heavier costs for fencing and other improvements. The results have shown a larger percentage of success and general prosperity upon the small unit.

RESULTS OF RECLAMATION.

The usual data were collected at the close of the irrigation season of 1915 regarding the results being attained by the irrigators. These figures show the annual advance in the settlement and development of the Government's reclamation projects. In 1915 over 1,000 farms and 50,000 acres were added to the cultivated area of the various projects and irrigation water was served to 18,600 producing farms. Over 800,000 acres were irrigated and crops were harvested from over 750,000 acres.

The new lands brought into production do not reach their full yield the first year, including young orchards just coming into bearing, new alfalfa stands giving a single cutting of hay, and other fields first brought into cultivation during the season and giving partial yields while being better prepared for full production. But in spite of the large addition to the producing area in 1915, there was an increase in the average return per acre over the preceding year. During 1915, the latest year for which crop statistics are available, the average for all reclamation projects in value of crops per acre was $24, an increase of 50 cents per acre in comparison with the statistics for 1914. At the same time the total production increased one and a half million dollars, to over $18,000,000.

It is interesting to note that 1915 was the first year since crop statistics have been gathered on the Government projects that the average crop value per acre shows a gain over the preceding year. That is, beginning with the figures for 1908 or 1909 there was a gradual reduction each year in the average reported crop value per acre until 1915, when there was a gain over 1914. This may be partially explained by the fact that the Reclamation Service began water service with a number of old irrigated tracts under canals acquired in connection with the Salt River, Uncompahgre Valley, and other projects and each year diluted this with added raw land not giving full production, tending to step down the general average return per acre. Acting in the other direction the raw land addition of each year has gradually reached more intensive production so that in 1914 this factor may have balanced the other and in 1915 the statistics have begun a trend in the other direction. It is also true that the early figures of crop production were roughly estimated, with the error naturally on the side of greater returns. There is now well established a relatively inexpensive system of collecting these data, but one probably more accurate than an ordinary census. Such data are available for the past three or four years, and in these the average return is fairly constant, but has decreased slightly and now increased, as noted above, with a change in any year small enough to be attributable to the many factors always affecting the business of farming.

In 1915 two projects were added to those producing annual crops worth over a million dollars—the Uncompahgre Valley, Colorado, and the North Platte, Nebraska-Wyoming. The Salt River project, Arizona, continues to lead in total returns with crops worth $3,660,000, closely followed by the Yakima project, Washington, producing from less than half as large an area crops estimated at $3,418,000.

The foregoing figures are restricted to areas covered by the water-user census or crop reports, which in general cover lands under canals operated by the Reclamation Service. On several of the projects additional areas received water developed by the project works, but delivered through canals not operated by the Government. This was the case on the Strawberry Valley project, Utah, where water was delivered for the first time from the Government works. In this way an additional 40,000 acres were served by the Government projects, bringing the total irrigated area to over 850,000 acres. At the same time the works were capable of serving nearly 1,500,000 acres.

The appended table shows the areas in use and estimated returns for the separate projects. The figures of the 1915 census are given in detail in the appendix.

Irrigation and crop results on Government projects, 1915.[1]

Project.	Irrigable acreage.[2]	Irrigated acreage.	Cropped acreage.[3]	Value of crops.	
				Total.[3]	Per acre cropped.
Salt River	[4] 219,691	[4] 179,350	171,832	$3,661,769	$21.31
Yuma	72,440	27,857	25,101	873,721	34.81
Orland	20,320	8,928	6,930	220,422	31.81
Uncompahgre Valley	65,000	41,463	40,553	1,044,915	25.76
Boise	150,000	76,705	69,818	1,526,873	21.87
Minidoka	120,000	83,562	77,008	1,725,515	22.41
Huntley	30,813	18,208	18,185	535,363	29.41
Milk River	22,200	4,192	3,887	51,249	13.18

[1] Data are for calendar year (irrigation season) except on Salt River project, Ariz., data are for corresponding "agricultural year," October, 1914, to September, 1915.

[2] Area Reclamation Service was prepared to supply water.

[3] Irrigated crops. Excludes small areas on few projects cropped by dry farming.

[4] Includes 4,239 acres, total area of towns contracting for water; farm area irrigated, 175,111 acres.

Irrigation and crop results on Government projects, 1915—Continued.

Project.	Irrigable acreage.	Irrigated acreage.	Cropped acreage.	Value of crops.	
				Total.	Per acre cropped.
Sun River	16,326	4,261	4,243	[1] $80,000	[1] $19.00
Lower Yellowstone	42,829	12,656	11,990	194,011	16.18
North Platte	129,714	70,007	68,130	1,263,617	18.55
Truckee-Carson	65,000	40,295	38,495	592,523	[2] 15.39
Carlsbad	24,796	13,470	11,322	245,684	21.70
Hondo	3,330	1,294	1,287	17,778	13.81
Rio Grande	45,000	33,876	32,246	1,103,389	34.22
Umatilla	17,000	5,306	3,603	104,653	29.04
Klamath	38,000	27,254	27,254	377,488	13.85
Belle Fourche	78,591	44,067	43,063	462,050	10.72
Okanogan	10,099	7,800	4,814	254,425	52.60
Yakima:					
Sunnyside unit	[3] 82,757	[3] 66,607	54,919	2,750,326	50.08
Tieton unit	34,000	22,000	18,100	668,650	37.00
Shoshone	42,816	25,753	24,833	410,031	16.51
Totals for irrigated areas covered by crop reports	1,330,222	814,906	757,613	18,164,452	24.00
Additional irrigated areas not covered by crop reports:					
Boise [4]	80,000	20,422			
Uncompahgre Valley [5]	4,500	4,500			
North Platte [6]	8,050	8,050			
Strawberry Valley [7]	50,000	8,900			
Totals, reclamation projects	1,472,772	856,778			

[1] Estimated. Crop reports covered 164 irrigated farms, with 6,665 acres cropped, of which 2,422 acres were not irrigated. Total crop value for 6,665 acres, $115,129, or $17.29 per acre.

[2] $22.60, excluding native pasture and other fields not in full production.

[3] Exclusive of Sunnyside and Snipes Mountain irrigation districts for which construction was largely completed during the year and small amounts of water delivered.

[4] Nampa-Meridian and Pioneer irrigation districts; New York Canal Co. lands.

[5] Under private canals supplied Gunnison water.

[6] North Platte Canal and Colonization Co. lands. In addition stored water was delivered to a number of private canals under the terms of the Warren Act.

[7] Government furnished stored water to supplement insufficient normal flow rights of Lake Shore and Spanish Fork units and Clinton district.

CROPS OF 1915.

The figures for 1915 show no marked change in the character of crops grown or their relative areas. More than half the total cropped area is devoted to hay and forage crops, slightly less than one-third to grains and less than 5 per cent each to fruit, vegetables, and sugar beets. There is evident a gradual increase in the proportionate area of bearing fruit. The depression in the cotton market that followed the outbreak of war in Europe resulted in a large reduction of the area utilized for this crop, and the later recovery in prices is not yet reflected in the statistics.

Alfalfa continues to dominate the crop statistics from the irrigated areas. In 1915 it occupied nearly half the cropped acreage and yielded over one-third the total crop value. Its many virtues readily explain this popularity. Once established, or a "stand" secured, it is a hardy plant and continues almost indefinitely to furnish good annual yields without reseeding. It gives several yields or cuttings each year. It is a legume with the peculiar power of drawing from the atmosphere the nitrogen in which the soils of the arid region are often deficient, and leaves behind more than it found of this valuable plant requirement. It is the deepest of subsoilers, penetrating with its many roots to a remarkable depth for the other essential elements of plant growth and improving the physical condition of the soil. It furnishes a hay of superior quality for conditioning and fattening stock, so effective in fact that it is now being utilized medicinally for humans.

A list of the principal crops grown on the projects is given in the attached table of results for 1915 showing the relative importance of the various crops in areas occupied and value of products.

Crop results on reclamation projects in 1915.[1]

Crop.	Acreage cropped.		Yields.			Crop value.		
	Total.	Per cent.	Unit.	Total.	Average per acre.	Average per acre.	Total.	Per cent.
Cereals:								
Barley	37,474	4.6	Bu.	947,463	25	$15	$576,420	3.2
Corn	39,785	5.3	Bu.	1,223,868	31	20	786,963	4.3
Oats	49,514	6.5	Bu.	1,496,153	30	13	664,572	3.7
Rye	780	.1	Bu.	11,116	14	11	8,332	.1
Wheat	84,052	11.4	Bu.	1,803,656	21	18	1,529,873	8.4
Total	211,605	27.9	Bu.	5,482,256		17	3,566,160	19.7
Other grain and seed:								
Alfalfa seed	14,517	1.9	Bu.	58,378	4.0	32	464,428	2.5
Clover seed	5,537	.7	Bu.	19,724	3.6	37	204,881	1.1
Sorghum (grain)	7,216	1.0	Bu.	252,324	35	22	161,541	.9
Flax seed	330		Bu.	3,714	11	20	6,681	.1
Millet seed	244		Bu.	2,412	9	11	2,761	
Total	27,844	3.6	Bu.	336,552		30	840,292	4.6
Hay and forage:								
Alfalfa hay	335,161	44.3	Ton.	979,915	2.9	19	6,460,239	35.6
Clover hay	6,726	.9	Ton.	12,071	1.9	11	76,333	.4
Other hay	12,484	1.6	Ton.	16,987	1.4	12	144,838	.8
Corn fodder	33,529	4.4	Ton.	58,977	1.8	20	682,698	3.8
Peas	927	.1	Bu.	16,681	18	31	29,183	.2
Other forage	870	.1	Ton.	6,355			22,387	.1
Pasture	98,128	12.9				[2]9	902,132	4.9
Total	487,825	64.3				17	8,317,810	45.8
Vegetables and truck:								
Beans	2,610	.4	Bu.	31,400	12	31	80,257	.5
Onions	324		Bu.	66,220	204	122	39,670	.2
Potatoes, white	17,269	2.3	Bu.	2,864,828	165	74	1,282,842	7.1
Potatoes, sweet	279		Bu.	19,477	70	41	11,302	
Truck	11,481	1.5				67	769,270	4.2
Total	31,963	4.2				68	2,183,341	12.0
Fruit and nuts:								
Apples	16,502	2.2	Lb.	41,530,159	2,500	52	864,591	4.8
Peaches	2,326	.3	Lb.	10,657,883	4,600	54	124,531	.7
Pears	1,755	.2	Lb.	9,216,780	5,250	89	155,577	.9
Prunes	302		Lb.	3,017,440	10,000	235	71,176	.4
Citrus fruit	1,167	.2	Lb.	2,166,212	1,850	68	79,858	.4
Small fruit	1,577	.2	Lb.	2,931,737	1,850	113	177,618	1.0
Other fruit and nuts	2,212	.3	Lb.	8,199,600		75	166,916	.9
Total[3]	[3]25,927	3.4	Lb.	[3]77,878,871		63	[3]1,647,509	9.1
Miscellaneous:								
Sugar beets	20,848	2.7	Ton.	225,854	11	59	1,236,049	6.8
Cotton	3,325	.4	Lb.	1,284,394	385	62	204,671	1.1
Hops	545	.1	Lb.	981,200	1,800	188	102,200	.6
Cane	1,411	.2	Ton.	7,458	5.3	24	34,419	.2
Other crops	1,335	.2					27,430	.1
Total	27,464	3.6					1,604,769	8.8
Duplication	55,015	7.0						
All crops	757,613	100.0				24	[4]18,164,452	100.0

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[1] Figures are limited to irrigated areas covered by crop reports, excluding about 40,000 acres irrigated but not covered by crop reports, and small areas cropped by dry farming on a few projects.

[2] This figure does not represent average value for pasture throughout the year as considerable areas pastured were also harvested and are included in the duplicated area.

[3] Totals include 86 acres yielding 159,060 pounds worth $7,242 not reported under separate fruits.

[4] Includes $4,571 not included under separate crops.

A summary of 18,624 irrigated farms shows the average farm contains 54 acres of irrigable land and 44 acres are actually watered, leaving 10 acres for fields not yet utilized, buildings, private roads, etc. On this average farm 20 acres are in alfalfa, 13 in grain, with small areas of other crops. The farmer crops a total of 41 acres. His total crop as harvested is worth a little less than 1,000, but he has three or four work animals to feed and by feeding the rest of his crop its value can be greatly increased. For this purpose he has cows, sheep, and hogs, in all some 25 animals. These are worth about $1,000; adding the price of his land and water-right payments, this average farmer is using a capital investment of $6,000. His success depends largely on what he pays for the use of this capital. If he is indebted for a large share of it at a high interest rate, he is likely to fail; if his capital is clear or indebtedness and interest low, his chance is excellent.

Summary of irrigated farms, 1915.[1]

Project.	Number of farms.	Irrigable acreage.[2]		Irrigated acreage.		Cropped acreage.		Crop value.	
		Total.	Per farm.	Total.	Per farm.	Total.	Per farm.	Total.	Per farm.
Salt River	3,004	194,866	65	175,111	58	171,832	57	$3,661,769	$1,220
Yuma	737	39,146	53	27,857	38	25,101	34	873,721	1,185
Orland	351	9,971	28	8,928	25	6,930	20	220,422	628
Uncompahgre Valley	1,107	62,147	56	41,463	37	40,553	36	1,044,915	944
Boise	1,727	99,973	58	76,705	44	69,818	40	1,526,873	884
Mindoka:									
Gravity unit	1,139	58,447	51	45,374	40	40,618	36	939,478	825
South Side pumping unit	621	39,857	64	38,188	61	36,390	59	786,037	1,265
Huntley	530	23,791	45	18,203	34	18,185	34	535,363	1,010
Milk River	48	10,113	211	4,192	87	3,887	81	51,249	1,065
Sun River[3]	164	9,027	55	4,243	26	[3]6,665	41	115,129	700
Lower Yellowstone	260	21,833	84	12,656	49	11,990	46	194,011	750
North Platte	1,095	87,554	80	70,007	64	68,130	62	1,263.617	1,155
Truckee-Carson	571	58,620	103	40,295	70	38,495	67	592,523	1,040
Carlsbad	325	15,086	46	13,470	41	11,322	35	245,684	755
Hondo	29	3,330	115	1,294	45	1,287	44	17,778	615
Rio Grande	1,092	40,700	37	33,876	31	32,246	30	1,103,389	1,010
Umatilla	306	9,698	32	5,306	17	3,603	12	104,653	340
Klamath	315	33,247	105	27,254	87	27,254	87	377,488	1,200
Belle Fourche	717	55,298	77	44,067	61	43,063	60	462,050	645
Okanogan	440	9,400	21	7,800	18	4,814	11	254,425	580
Yakima:									
Sunnyside unit	2,553	68,840	27	66,607	26	54,919	21	2,750,326	1,075
Tieton unit	995	24,900	25	22,000	22	18,100	18	668,650	670
Shoshone	498	30,591	61	25,753	52	24,833	50	410,031	825
Total	18,624	[2]1,006,435	54	810,649	44	760,035	41	18,199,581	978

[1] Limited to irrigated farms covered by crop reports, excluding about 40,000 acres irrigated, but not covered by crop reports, and small areas cropped by dry farming on a few projects.

[2] These figures cover only irrigated farms; hence the irrigable acreage is less than that for the projects as a whole, as given in other tables.

[3] Crop reports covered 164 irrigated farms, which included 4,243 acres irrigated and cropped; also 2,422 acres cropped without irrigation.

OPERATION AND MAINTENANCE.

The operation and maintenance of the project irrigation works have been carried on during the fiscal year with considerably less friction between the irrigationists and the operation and maintenance forces than during any preceding period. This is gratifying, particularly in view of the fact that the system of basing operation and maintenance charges on the quantity of irrigation water used was being put into effect and variations in total charges between neighboring water users have been apparent.

During the year there have been very few mishaps in the operation of the project irrigation works. Extraordinary floods caused considerable damage in the Southwestern States, but similar damage was also suffered by all property in the same sections. The continued successful operation of the project works speaks well for the plans by which the systems were built and the construction methods employed.

With the possible exception of the Yakima project, all projects had a bountiful supply of irrigation water during 1915. The crops on the Yakima project were not seriously affected, but economy in use of water had to be enforced. Storage provisions for all the projects appear to be adequate and the supplies from the storage readily available.

Of special interest in the maintenance of the canal systems has been the use of sheep and goats in keeping canal banks free from vegetation. On the Salt River project, where Johnson grass and other growths were particularly objectionable, the experiment of using Government-owned sheep to clean the canal banks was first tried out with marked success. The scope of this work has been enlarged on that project, and Government-owned sheep have also been secured for use on canal banks on the Rio Grande project. On the Yuma and Orland projects the use of privately owned sheep has been encouraged by Government assistance in fencing stretches of the canals to be kept clean. In addition to keeping the canal banks clean it has been found that the trampling of the sheep compacts and improves the banks and reduces the likelihood of breaks due to burrowing gophers and similar pests.

SOIL CLASSIFICATION.

Additional experience gained during this period further indicates the desirability for reasonably close classification of the soils on some of the projects with respect to the duty of water on the various types. An acre-foot of water delivered to porous or sandy soil will not perform the same duty as the same amount delivered to nonporous soil and the value of the water is correspondingly less to the irrigationist. Such a classification of soils has been fairly well worked out on the Minidoka project in Idaho, where the Department of Agriculture made soil classification and duty of water studies during the season of 1915. Pending a proper classification of soils, the fixing of operation and maintenance charge schedules in such manner as to approximate a flat rate per acre will prevent serious inequities among water users on projects where the types of soil vary considerably.

While the basing of operation and maintenance charges on the amount of irrigation water used per acre has worked some disadvantages due to varying types of soil, this plan has worked economies in the handling of project works as the water has been used more conservatively and more timely irrigations have been effected. The irrigationists are now studying the use of water, which is beneficial to both the land and the landowner.

Operation and maintenance charges have not decreased on all the projects during the past year, because of the necessity of considerable maintenance work on some, but in general the decrease per acre has been encouraging and further economies are still possible.

The landowners are demonstrating an increasing interest in the businesslike operation of the projects. As a rule, conservative business men are taking places as officers of water-users' associations, and the past year has seen some effective cooperation between these organizations and the local officers of the Reclamation Service in handling problems that previously have been passed on to the department for consideration and settlement.

BETTER FARMING.

The farmers on the projects are steadily improving in the matter of crop production. General conditions, such as climate and transportation facilities, control to a large extent the kinds of crops produced on each project. The proper selection of crops is being worked out, and the farmers are taking up practical crop rotations which have been demonstrated as advantageous in their respective localities. The good results of better crop selections, more thorough cultivation, better methods of irrigation, and crop rotation are gradually and increasingly apparent each year. On some of the projects there is still a limited production of unprofitable crops, which will in time give way to more profitable farming. The maximum per acre returns on the irrigated lands have not been approximated as yet.

LIVE STOCK ON THE PROJECTS.

As has been apparent from the beginning of irrigation farming in this country, the road to prosperity is through the production and feeding of live stock on the irrigated lands. During the first few years following the settlement of the Government projects the settlers were not financially able to secure good breeding stock, and local business interests were not inclined, for various reasons, to support the settlers in the purchase of breeding stock. During the last few years, and particularly in 1915, these conditions have changed materially. Local business interests have decided that they will profit by having plenty of live stock on farms in their vicinities, and they are willing to furnish capital for such enterprises.

Excellent assistance in the purchase, care, and feeding of all classes of live stock has been given the project farmers by the agriculturists assigned to several of the projects, under the direction of Mr. F. D. Farrell, of the Department of Agriculture. That department, after considering conditions on the projects, decided that the greatest advantage would accrue to the farmers by the assignment to the projects of men educated and trained particularly along animal-husbandry lines, and this course has proved wise. Losses to the farmers by reason of live-stock diseases have been minimized by the presence on the projects of these trained men, and the advantages of their help in the purchase of breeding stock will be continually apparent hereafter.

Increases in the live stock handled on the projects have created marketing facilities for much forage and bulk feeds heretofore unmarketable at a profit. Further improvements in marketing facilities are much needed by our settlers. It is true, however, that much of this work of securing better markets depends directly on the farmers themselves. Decided improvements must be made in the standardization of both crops and live stock before improvements in marketing facilities can well be started. Standards of quality for each project must be fixed and the production brought up to such standards. When this is accomplished the market question will be solved, as the demand for excellent products is unvarying, while indifferent products are not handled profitably even during periods of heavy demand.

In connection with the assignment by the Department of Agriculture of agriculturists to a number of the projects the farmers on these projects have had the benefit of visits by experts from that department who have given special assistance in the establishment of creameries, cheese factories, and cooperative selling organizations and along other lines tending to better market conditions. Special men to handle live-stock diseases have also been available. It would be a decided advantage if the Department of Agriculture would extend the scope of the demonstrations on reclamation projects to include an agriculturist on each project.

WORK OF THE SETTLEMENT SECTION.

The settlement section of the service is cooperating with the various water users' associations, the immigration agents of States and railroad companies, and others, with a view to completing plans for securing competent settlers. On several of the projects considerable areas of land are held in large tracts by private interests which are under contract with the Government to subdivide and sell to bona fide settlers. The settlement section is cooperating with the water users' associations on several of these projects for the subdivision and settlement of these excess lands. The advantages of this plan consist in securing competent farmers and also in safeguarding the homeseeker from unscrupulous land agents and in some cases rendering him financial assistance for the purchase of live stock.

IMPROVEMENT IN SOCIAL AND ECONOMIC CONDITIONS.

The project farmers have not been turning all available money into live stock and similar investments, but have utilized a great amount in bettering social and educational conditions. With the help and encouragement of the service the settlers are rapidly being organized into cooperative associations which are extended to all activities—business, educational, and social. Under the encouragement and assistance given, life on many of the projects has been made attractive, and the country has lost its isolation and loneliness. The centralized graded school is growing in popularity and has been established on many of the projects. It may be safely stated that the greatest advancement made in educational lines in Western States has been on the irrigation projects where the settlers have taken the lead in providing modern and well-equipped school buildings, well-qualified teachers, and attractive surroundings.

The act of October 5, 1914, authorized the Secretary of the Interior to withdraw from other disposition and reservation land for community centers for the use of residents on the reclamation projects of the Government, and this provision of the law has been utilized in many sections. The project women have been particularly active in building community houses and forming community clubs and other organizations which bind individuals in closer relations. More than 200 women's organizations have been reported, a large percentage of them being affiliated with State and National federations. That they are already an important factor in the upbuilding of the West is well recognized and they are working side by side in effective cooperation with boards of trade, chambers of commerce, and other organizations for better farms, better health, better schools, better communities, and better homes.

Settlement data for reclamation projects, 1916.

State and project.	Towns.		Total population of farms and towns.	Number of public schools.	Number of churches.	Banks.			
	Number.	Population.				No.	Capital stock.	Deposits.	Number of depositors.
Arizona, Salt River	12	31,000	53,000	60	50	10	$1,133,500	$7,489,265	....
Arizona-California, Yuma	4	4,535	6,621	16	7	3	160,000	896,450	....
California, Orland	1	1,550	3,250	8	7	2	141,000	445,000	1,800
Colorado, Uncompahgre Valley[1]	3	6,500	10,061	24	26	8	360,000	2,083,999	8,000
Idaho:									
Boise	10	34,350	46,910	22	52	15	1,750,000	9,000,000	24,850
Minidoka	5	4,100	10,568	21	21	6	140,000	1,311,641	6,370
Montana:									
Huntley	8	468	2,518	8	6	3	60,000	307,414	1,180
Milk River	5	4,200	4,600	14	14	7	252,000	1,959,000	6,615
Sun River	3	210	785	4	4	1	20,000	61,000	264
Montana-North Dakota, Lower Yellowstone	8	2,145	2,966	19	5	9	230,000	1,388,000	5,637
Nebraska-Wyoming, North Platte	7	5,500	9,700	34	25	16	352,000	1,800,000	6,000
Nevada, Truckee-Carson	4	1,510	3,500	19	9	1	100,000	342,000	700
New Mexico:									
Carlsbad	4	3,000	3,912	7	8	2	80,000	737,000	1,694
Hondo	1	7,500	7,602	3	9	4	350,000	2,500,000	....
New Mexico-Texas, Rio Grande	25	81,000	92,000	55	92	20	3,275,000	26,002,000	51,000
North Dakota, North Dakota pumping:									
Williston unit	2	5,000	5,175	5	6	3	185,000	1,500,000	3,300
Buford-Trenton unit	2	400	470	3	2	2	20,000	115,000	240
Oregon, Umatilla	3	900	1,800	5	6	1	25,000	85,000	600
Oregon-California, Klamath	4	5,000	6,580	20	9	3	175,000	1,219,846	4,281
South Dakota, Belle Fourche	5	1,667	4,142	23	11	9	140,000	1,297,000	4,228
Washington, Okanogan	3	1,650	2,600	7	8	4	135,000	400,000	1,700
Washington, Yakima:									
Sunnyside unit	13	5,268	13,112	34	30	9	309,573	1,112,296	5,674
Tieton unit	[2] 7	21,000	23,800	10	[3] 3	....	....	....	....
Wyoming, Shoshone	4	650	2,450	6	7	3	60,000	252,746	1,500
INDIAN PROJECTS (see note).									
Montana:									
Blackfeet	4	1,425	1,578	6	8	3	....	....	....
Flathead	12	3,460	17,460	51	15	9	205,000	745,733	3,669
Fort Peck	5	2,200	4,292	[4] 10	7	4	110,000	477,000	1,970
Total	164	236,188	341,452	494	447	157	9,768,073	63,527,390	141,272

[1] Data for 1915.
[2] On and adjacent to project.
[3] Not including schoolhouses at which services are held.
[4] Five white and five Indian.

NOTE.—The Indian projects are separately classified because they are not constructed under the terms of the reclamation law, but in each case are authorized by specified statute in connection with the appropriations for the Indian Office.

DRAINAGE.

A more detailed discussion of the causes of seepage and water logging of soils may be found in the twelfth, thirteenth, and fourteenth annual reports. A description of the drainage work in progress will be found under the discussion of projects.

The construction of drainage works to relieve seeped conditions and protect lands from excess water was continued on the Boise, Huntley, North Platte, Rio Grande, Truckee-Carson, Klamath, and Shoshone projects during the year 1915–16. On the Flathead project drainage construction was also carried on for the relief of seeped areas in the town of Polson, on the southern shore of Flathead Lake. Surveys and investigations have been prosecuted leading to the planning of drainage works for the Yuma, Salt River, Uncompahgre, and Belle Fourche projects. Surveys and preparation of plans for drainage works for the Grand Valley drainage district were begun. This work is being done under contract between the United States and the district.

Estimates of seepage and summary of drainage work to June 30, 1916.

Projects.	Drains.		Estimated area damaged by seepage.	Estimated area protected by constructed drains.	Estimated area to be protected when all drains authorized are constructed.
	Open.	Closed.			
	Miles.	*Miles.*	*Acres.*	*Acres.*	*Acres.*
Arizona-California: Yuma	11.5	4	2,600	5,000	17,500
Colorado:					
Grand Valley	.7	....	275	50	....
Uncompahgre Valley	....	....	15,000	....	....
Idaho:					
Boise—					
Pioneer irrigation district	72.7	.8	10,500	25,000	30,000
Nampa-Meridian district	14.2	....	6,200	10,000	50,000
Other parts of project	9.7	....	2,050	3,500	3,500
Minidoka	108	....	543	63,933	64,000
Montana:					
Flathead	.18	1.47	360	540	700
Huntley	11.57	38.02	2,000	17,000	24,000
Sun River	....	....	2,300	....	....
Montana-North Dakota: Lower Yellowstone	5.6	....	1,300	1,600	....
Nebraska-Wyoming: North Platte	17.5	9.7	2,900	4,000	5,000
Nevada: Truckee-Carson	....	3.79	10,000	....	....
New Mexico: Carlsbad	2.3	3.8	3,000	870	5,200
New Mexico-Texas: Rio Grande	1.8	....	40,000	1,000	(1)
Oregon:					
Klamath	49	....	5,600	17,000	29,600
Umatilla	10	....	200	2,000	2,000
South Dakota: Belle Fourche	....	....	3,000	....	....
Wyoming: Shoshone	10.32	55.05	1,000	15,500	20,500
Total	325.07	116.63	106,228	166,993	252,000

[1] Tentative plans have been formed for the drainage of 100,000 acres, but drainage lines that will protect only 12,000 acres have been approved. The approval of further work is suspended pending the formation of irrigation districts.

The drainage works constructed have generally been effective in lowering the ground waters on areas they have been intended to serve. The results have been the reclamation of areas already seeped and the protection of additional areas where seepage was threatened. The progress of reclaiming lands from the effects of seepage and water logging after the water table has been lowered depends in a large measure upon the care used in cultivation and washing out the alkali from the surface soils. Lands that have been in a seeped condition for some time ordinarily have an accumulation of alkali salts on or near the surface and are tightly compacted, due to the continued action of water upon them. Such lands require great care in order to bring them into a condition suitable for growing crops. Where drainage works have been provided and the water table lowered before the lands have become water-logged and alkaline, no especial difficulty is experienced in getting crops started upon them. In some instances drains have been built and the ground water lowered without serious crop losses.

Observations to determine the height of water table have been carried on over various projects. The purpose of this work is to anticipate any rise in ground waters that would cause seepage conditions and also to furnish necessary data for planning drainage works. In order to protect lands from becoming seeped and the resultant crop losses on large areas, it is necessary that the construction of drainage works be started before the water table rises sufficiently high to destroy the irrigability of the land and render it unfit for crop production.

The reclamation extension act, section 4, provides that no increase in construction charges shall hereafter be made after they have been fixed by public notice, except by agreement between the Secretary of the Interior and a majority of the water-right applicants and entrymen to be affected by such increase. This has made it necessary in many cases where drainage works were required that a sufficient number of water-right applicants make agreements before construction work could be begun. During the year 1915–16 supplemental drainage construction was carried on on the Huntley, Shoshone, and Klamath projects. This requirement of making contracts for supplemental construction tends in a manner to delay the taking up of work. Where seepage has appeared on but a small portion of the project, the settlers on lands not so affected do not in all cases realize the necessity of constructing drains in order to prevent the spread of seepage. It is only when a majority of the settlers on a project have been brought to see the necessity of such work for protecting their lands that funds for the work can be provided.

In connection with the construction of drains, especially those of the closed type, studies have been made of various materials available for such construction. These studies have led to the adoption of specifications for tile based upon inspection and strength tests. The inspection and tests of this material have been carried on largely by the office of the cement expert.

POWER DEVELOPMENT.

On several of the projects power has been developed to supply irrigation and drainage pumping plants and the requirements of construction work. In some cases surplus power is available and such power is being sold for domestic and industrial use. The sale of excess power has not only resulted in a considerable income in many cases but has also been an important factor in the development of the projects and the improvement of the living conditions of the communities.

Hydroelectric developments on irrigation canals or at storage reservoirs are as a rule not well adapted to straight commercial service, due to the great seasonal variation of stream flow available for the generation of power, but with an irrigation pumping load the greatest power demand is often nearly coincident with the greatest supply and such sites can be economically developed. Power for such purposes can usually be developed cheaper in connection with an irrigation project than as a purely power proposition, since many of the preliminary expenses and often much expensive construction work is borne in part at least by the gravity-irrigation development. Furthermore, where the developments are made by the Reclamation Service the expenses of promotion and financing are eliminated and there are no interest charges. In general, the conditions are therefore favorable for power development for pumping purposes and for low cost of surplus power for commercial use.

In the construction of the larger dams electric power has been used almost exclusively, and owing to its great flexibility and ease with which it can be distributed to the various pieces of equipment, it has been an important factor in cheapening and expediting the work. Special care has been taken to protect the workmen from accidental injuries, and notwithstanding extensive use of 2,200-volt current, few serious accidents have occurred. Electricity has also been employed successfully in the construction of irrigation and drainage canals by means of motor-operated steam shovels and dragline excavators. The larger part of the power required has been supplied from developments made by the Reclamation Service, although in a few instances power has been purchased from commercial companies. Power plants have as a rule been designed and constructed for permanent operation, the surplus power during the construction period being sold commercially, and upon completion of the work the entire output of the plant becomes available for such disposition. In two cases power plants have been leased under competitive bids to be operated by private companies.

The following tables show the power and pumping plants installed on the various projects and the results of operation for the fiscal year ending June 30, 1916.

Power plants operated by United States Reclamation Service, fiscal year 1915–16.

Project.	Name of plant.	Type.	Capacity.	Number of units.	Head.	First cost of plant.	Output.	Cost per kilowatt-hour, without depreciation.	Cost per kilowatt-hour, depreciation only.	Distribution of power generated (kilowatt-hour).						Gross income from power sales.
										Sold to customers.	Used for irrigation pumping.	Used for construction.	Used for camp lights.	Used for drainage work.	Losses.	
			Kilowatts.		*Feet.*		*Kilowatt-hours.*	*Cents.*	*Cents.*							
Salt River.........	South Consolidated.	Hydro-electric.	2,000	2	31	$163,139.60	5,783,500	0.249	0.091	26,467,774	2,726,149	33,572	60,853	....	2,015,842	$273,199.53
Do............	Cross Cut.....	.....do.....	5,000	6	111	480,454.60	6,160,009	.159	.275							
Do............	Arizona Falls.	.....do.....	1,000	2	19	109,500.73	3,439,540	.200	.112							
Do............	Roosevelt.....	.....do.....	10,000	6	225	557,559.86	15,921,150	.291	.308							
Minidoka.........	Minidoka.....	.....do.....	7,000	5	46	[1] 484,904.82	38,019,380	.058	.0038	12,414,758	20,750,229	....	876,525	632,070	3,345,798	53,675.82
Boise..............	Boise..........	.....do.....	1,875	3	30	[1] 167,906.37	2,818,510	.4207	....	1,172,233	....	[2] 569,130	....	1,077,147	....	8,104.89
Truckee-Carson....	Lahontan [3]....	.....do.....	1,875	3	112	136,828.00	....	....	....	....	....	....	....	....	....	13,014.31
Strawberry Valley	Spanish Fork.	.....do.....	850	2	123	[1] 68,812.15	6,840,555	1	.1	740,031	....	....	30,316	....	9,773	36,502.72
Okanogan.........	Power plant No. 1.[4]	.....do.....	187	1	105	10,880.15	....	....	....	....	....	....	....	....	....	....
Do............	Power plant No. 2.[4]	.....do.....	187	1	58	12,675.50	....	....	....	....	....	....	....	....	....	....
Rio Grande.......	Hydroelectric power plant.	.....do.....	150	1	170	8,440.00	145,050	1.41	.14	10,461	....	966,530	92,409	....	....	1,710.22
Do............	Temporary steam power plant.[5]	Steam-electric.	1,500	3	......	164,000.00	1,069,400	2.17	1.65							
North Dakota pumping.	Williston......	.....do.....	1,150	5	......	288,699.39	961,160	2.19	.13	699,350	....	....	[6] 244,764	....	37,046	26,059.75

[1] Includes operator's quarters.
[2] Includes power used for lights.
[3] Leased to Canyon Power Co. for 10 years beginning Dec. 1, 1914.
[4] Plant not operated during year.
[5] Operation permanently discontinued June 3, 1916.
[6] Also energy used for auxiliaries.

Pumping plants operated by the United States Reclamation Service during fiscal year 1915–16.

Project.	Name of plant.	Type.[1]	Capacity of prime movers.	Number of units.	Head pumped against.	First cost of plant.	Energy used for pumping.	Acre-feet pumped.	Cost per acre-foot.
			Horsepower.		*Feet.*		*Kilowatt-hours.*		
Salt River..	Battery A...	V. M. D. C...	75	1	49.0	$16,425.49	57,300	631.6	$1.93
Do.....	Battery B...	.....do......	75	1	46.2	20,603.87	139,128	1,775.0	1.176
Do.....	Battery C...	.....do......	75	1	48.4	16,734.94	141,891	1,843.84	1.005
Do.....	Battery D...	.....do......	75	1	46.5	19,358.12	158,220	2,261.88	.998
Do.....	Battery E...	.....do......	75	1	44.5	21,848.29	146,453	1,977.88	1.167
Do.....	Battery F...	.....do......	75	1	32.0	16,808.09	108,060	1,488.68	1.192
Do.....	Clemans.....	H. M. D. C...	100	1	31.3	8,124.41	156,602	1,945.4	.966
Do.....	San Francisco.	.....do......	100	1	30.0	29,978.98	40,984	525.5	3.545
Do.....	McQueen well.	V. M. D. C...	75	1	40.0	17,254.44	60,601	675.1	.877
Do.....	High line....	H. M. D. C...	150	3	43.0	27,228.70	1,716,910	28,498.1	.547
Minidoka...	First lift....	V. M. D. C...	2,760	5	29.14	180,314.33	8,182,910	177,419	.2422
Do.....	Second lift..	.....do......	2,400	4	30.34	187,090.51	12,199,400	147,411	
Do.....	Third lift....	.....do......	1,560	3	29.94	99,951.49		87,072	
Do.....	West end...	H. M. D. C...	150	2	20.74	18,371.56	342,076	6,819.97	.2870
Do.....	1812 pumping station.	.....do......	5	1	3.77	1,008.76	3,386	230.49	.4130
Do.....	A 4 raise....	Scoop wheel.	25	1	2.91	3,202.34	19,726	1,996.80	.1074
Do.....	1817 raise....	.....do......	10	1	5.19	3,636.04	2,248	430.81	.2580
Do.....	114 pumping station.[2]	H. M. D. C...	7.5	1	7	2,891.61	483	....	....
North Dakota Pumping.	Substation A.[3]	.....do	175	2	27.4	12,550.36	....	....	....
Do.....	Substation B.[3]	.....do......	100	1	27.4	7,386.45	....	....	....
Do.....	Barge[3]......	.....do......	540	4	30.0	34,712.09	....	....	....
Do.....	Substation D.[3]	S. T. D. C....	40	1	21.6	Part of steam plant.	....	....	....
Do.....	Substation E.[3]	.....do......	450	2	50.7		....	....	....
Huntley....	Balantine pumping station.	V. T. D. C...	596	2	46.32	71,522.30	....	6,508	.054
Okanogan..	Robinson flat pumping.[3]	H. M. D. C...	200	2	188	27,673.04	....	....	....
Yuma......	Reservation drainage pump.	G. E. D. C...	110	2	5 to 6	6,775.60	....	2,800	.583
Do.....	Yuma Valley pumping plant.[4]	.....do	40	2	4	900.90	....	758	.928
Yakima....	Snipes Mountain.	V. T. D. C...	500	2	197	[5]42,030.00	....	2,005	1.15
Do.....	Hillcrest....	.....do......	35	1	103	5,660.00	....	175	.35
Do.....	Outlook.....	.....do......	800	2	109	[6]82,850.00	....	1,640	....

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[1] Type V. M. D. C.—vertical motor-driven centrifugal pump. Type H. M. D. C.—horizontal motor-driven centrifugal pump. Type S. T. D. C.—steam-turbine-driven centrifugal pump. Type G. E. D. C.—gas-engine-driven centrifugal pump. Type V. T. D. C.—vertical hydraulic-driven centrifugal pump.

[2] Completed June 30, 1916.

[3] Plant not operated during year.

[4] Temporarily installed.

[5] Plant 70 per cent complete.

[6] Plant 92 per cent complete.

Contracts for sale of power in force June 30, 1916.

Project.	Name of contractor.	Date of contract.	Date of expiration.	Limit of load.	Rate per kilowatt hour.	Gross income fiscal year 1915-16.	Remarks.
				Kilowatts.	*Cents.*		
Salt River	Salt River Water Users Association (Indian contract).	May 11, 1907	Perpetual	750	At cost	$2,335.80	
Do	Pacific Gas & Electric Co	June 22, 1907	Sept. 30, 1919	1,500	[1] 1.5	93,995.25	
Do	Roosevelt Mercantile Co	Mar. 1, 1911	Mar. 1, 1916		5	183.50	Service continued under same contract pending new contract.
Do	S. D. Lount & Sons	May 22, 1916	May 21, 1917	100	4 to 1.33	4,734.20	
Do	Town of Glendale	Feb. 6, 1914	Mar. 16, 1919	200	5 to 1.67	3,280.88	
Do	Consolidated Canal Co	Dec. 23, 1912	Perpetual	300	1	10,911.00	
Do	Inspiration Consolidated Copper Co	July 15, 1912	Aug. 2, 1922	8,000	.75	135,498.66	
Do	R. P. Davie	May 1, 1916	Sept. 30, 1916	100	1.75	390.75	
Minidoka	E. B. Skinner	Mar. 9, 1910	Mar. 9, 1920	100-1,500	[2] 2.7 to .5	1,671.60	$1,500 minimum per calendar year.
Do	Rupert Electric Co	Mar. 16, 1910	Mar. 16, 1920	100-1,750	[3] 2.7 to .5	8,699.64	Do.
Do	City of Burley	Apr. 21, 1910	Apr. 21, 1920	175-1,800	[4] 2.7 to .5	10,367.73	Do.
Do	Amalgamated Sugar Co	Sept. 16, 1912	Dec. 21, 1922	5-170	[5] Minidoka standard	4,096.84	
Do	R. E. Scoville	Jan. 19, 1913	Apr. 8, 1918	.5	do	14.49	
Do	Minidoka N. S. Power Co	Apr. 1, 1913	Sept. 2, 1923	2	do	181.96	
Do	Portland Feeder Co	Sept. 13, 1913	Oct. 17, 1916	42	do	944.72	
Do	Noah C. Lowry	Nov. 23, 1913	Dec. 11, 1923	.5	do	44.96	
Do	Paul Electric Co	Jan. 20, 1914	Feb. 13, 1924	5-10	do	645.27	
Do	Farmers' Electric Co	June 1, 1914	June 29, 1924	2	do	86.27	
Do	Lee St. Clair	Sept. 15, 1915	Oct. 1, 1925	.5	do	23.36	
Do	Harvey Moncur	Sept. 16, 1914	Oct. 9, 1924	1	do	23.53	
Do	J. R. Cattel	Sept. 25, 1914	Oct. 12, 1924	1	do	23.46	
Do	Ernest J. Hanson	Oct. 21, 1914	Dec. 30, 1924	.5	do	13.51	
Do	S. G. Clayville	do	Jan. 2, 1925	1-.5	do	22.45	
Do	Mathias Christien	do	do	1	do	24.61	
Do	W. A. Drew	do	do	1-.5	do	34.06	
Do	James H. Lewis	do	Feb. 9, 1920	1-.5	do	30.74	
Do	W. T. McCord	do	Jan. 2, 1918	1-.5	do	32.62	
Do	John D. Hunsinger	do	do	1-.5	do	22.31	
Do	E. T. Hollenbeck	do	do	1-.5	do	24.16	
Do	Thos. B. Anderson	do	do	1-2	do	43.99	
Do	A. F. Ames	do	do	1	do	24.83	
Do	Schodde Electric Co	May 24, 1915	June 28, 1925	5-7	do	78.30	
Do	L. G. Taylor	May 25, 1915	Sept. 3, 1925	.5	do	14.48	
Do	W. E. Helm	do	do	.5	do	14.72	
Do	E. C. Holley	do	do	.5	do	51.09	
Do	James M. Still	July 26, 1915	Aug. 10, 1925	.5	do	14.24	
Do	Burley Mill & Elevator Co	Oct. 2, 1915	Nov. 5, 1920	10	do	233.31	$33.33 minimum each month.

Do	Frank W. True	Oct. 12, 1915	Jan. 3, 1926	.5	do	7.67	
Do	Village of Albion	Oct. 15, 1915	Jan. 8, 1926	30-100	do	210.45	Guarantee of $47,000 during life of contract.
Do	W. A. Gill	Oct. 18, 1915	Jan. 11, 1926	.5	do	7.67	
Do	W. M. Jordan	Dec. 8, 1915	Apr. 3, 1926	.5	do	6.45	
Do	Acequia Dairy & Produce Co.	Mar. 1, 1916	May 19, 1926	.5	do	1.12	
Strawberry Valley	Spanish Fork City	Oct. 9, 1912	Oct. 9, 1918	400	[6] 1	3,437.48	Supplemental July 13, 1915.
Do	Payson City	Oct. 1, 1911	Oct. 1, 1917	100	[7] 1	4,132.50	Supplemental July 27, 1914.
Do	Town of Salem	Mar. 25, 1912	Mar. 25, 1918	50	[8] 1.5	739.65	Supplemental Jan. 19, 1915.
Do	John B. Jex	Mar. 20, 1915	Mar. 20, 1916	5	9	37.55	
Do	Joseph Lucas	Mar. 20, 1916	Mar. 20, 1917	5	9	6.51	
Truckee-Carson	Canyon Power Co.	July 10, 1914	Nov. 30, 1924		[9] 25-.375	13,041.31	
Do	W. A. Harmon	May 29, 1914		239	5	51.95	Minimum per month, $3.
Do	T. Dolf	do		59	5	36.00	Do.
North Dakota Pumping	City of Williston	Oct. 16, 1912	Dec. 20, 1922	600	[10] 4.5-2	26,059.75	

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[1] Consumer's rates: House lighting 6 to 9 cents per kw. hr.; business lighting 3 to 9 cents per kw. hr.; power 1.5 to 6 cents per kw. hr.

[2] Consumer's rates: Lighting 5.5 to 7 cents per kw. hr.; heating $1 to $2.50 per month per 1,000 watts capacity; power 0.55 to 6 cents per kw. hr. plus 50 to 75 cents per month per connected h. p.

[3] Consumer's rates: 5 to 25 cents per light per month; heating $1.25 to $2.50 per month per 1,000 watts capacity; power 0.55 to 6 cents per kw. hr. plus 50 to 75 cents per month per connected h. p.

[4] Consumer's rates: Lighting 5.5 to 7 cents per kw. hr.; heating $1 to $2.50 per month per 1,000 watts capacity; power 0.55 to 6 cents per kw. hr. plus 50 to 75 cents per month per connected h. p.

[5] *Minidoka Standard rates for electric light and power.*

	Per kw. h
First 50 hours' use of maximum demand	$0.04
Next 50 hours' use of maximum demand	.03
Next 50 hours' use of maximum demand	.02
Next 150 hours' use of maximum demand	.01
Balance hours' use of maximum demand	.005

Above rates increase 25 per cent during June, July, and August.

Above rates subject to following discounts:

For maximum demand of—	Per cent.
2 kilowatts and less than 4 kilowatts	2
4 kilowatts and less than 7 kilowatts	4
7 kilowatts and less than 11 kilowatts	6
11 kilowatts and less than 15 kilowatts	8
15 kilowatts and less than 19 kilowatts	10
19 kilowatts and less than 24 kilowatts	12
24 kilowatts and less than 29 kilowatts	14
29 kilowatts and less than 35 kilowatts	16
35 kilowatts and less than 41 kilowatts	18
41 kilowatts and less than 48 kilowatts	20
48 kilowatts and less than 57 kilowatts	22
57 kilowatts and less than 67 kilowatts	24
67 kilowatts and less than 80 kilowatts	26
80 kilowatts and less than 100 kilowatts	28
100 and over	30

Minimum payment shall not be less than $1.80 per month per kilowatt of the contractor's agreed maximum demand. All above rates subject to 10 per cent discount if energy is delivered and metered at approximately 2,200 or more volts or 8 per cent if delivered at approximately 2,200 or more volts and metered at a lower voltage.

[6] Consumer's rates: Lighting 10 cents per kw. hr. less 10 per cent for cash; heating and cooking 3 cents per kw. hr.; power 2.5 to 3.5 cents per kw. hr.

[7] Consumer's rates: Lighting 8 cents for first 10 kw. hr.; 6 cents for all over that amount; power 3 cents per kw. hr.

[8] Consumer's rates: Lighting 10 cents per kw. hr. less 10 per cent for cash.

[9] Consumer's rates: Residences 5¾ to 15 cents per kw. hr.; power 2 to 6½ cents per kw. hr.

[10] Consumer's rates: Lighting 10 cents per kw. hr.; cooking 4 cents per kw. hr.

UNDEVELOPED POWER.

In the following table are listed the power sites which have been investigated more or less completely by the Reclamation Service but which have not been developed. The data given are necessarily in many cases only roughly approximate, but the table serves to indicate the great power possibilities of the projects.

Undeveloped water power.

Project.	Name of plant.	Head.	Horsepower.
Arizona-California:		*Feet.*	
Yuma	Drop in California Canal	10	1,200
Do	Araz	22	9,000
Do	Laguna Dam (doubtful)	9-18	4,000
California:			
Iron Canyon	Iron Canyon	60-130	35,000
Orland	Drop, high line to South Canal	27	678
Pit River	Hat Creek	200	9,000-12,000
Do	Fall River	70-400	7,000-40,000
Do	Big Bend	800-900	150,000
Colorado:			
Grand Valley [1]	Main Canal	31-48	3,000
Uncompahgre [1]	Various sites	18-160	40,000
Idaho:			
Boise	Arrowrock Dam	60-230	10,000-20,000
Do.[1]	Various sites	20-90	1,900
Minidoka	Minidoka Dam	46	10,000
Do	Head of Walcott Lake	46	30,000
Montana:			
Flathead (Indian)	No. 1 Newell Tunnel	169	130,000
Do	No. 2 Buffalo Dam	48	38,000
Do	No. 3	24	19,000
Do	No. 4	88	70,000
Do	No. 5	19	15,000
Huntley	Second drop, main canal	41	275
Montana-North Dakota:			
Lower Yellowstone [1]	Lateral K. K. drop	34	314
Nebraska:			
North Platte [1]	Pathfinder Dam	60-200	17,000-60,000
Nevada:			
Truckee-Carson	Lahontan	120	5,000
Do	26 foot drop	26	2,900
New Mexico-Texas: Elephant Butte.	Elephant Butte Dam	65-185	12,000
Oregon:			
Columbia River	Celilo Falls	45-105	500,000-800,000
Deschutes	4 sites	65-110	90,000-100,000
Silver Lake	Silver Creek	48-120	2,900
Umatilla	Drainage outfall	28	145
Warner Valley	Deep Creek		2,000
Willamette Valley	Santiam River and Marion Lake		14,000
Do	McKenzie River, 2 plants	415-550	30,500
Do	Middle Fork Willamette and Waldo Lake Storage.	[2] 4,400	65,000
Oregon-California: Klamath	Various sites	21-88	10,000
Utah: Strawberry Valley	Spanish Fork	126	1,500
Washington:			
Columbia River	Priest Rapids	60	200,000
Okanogan	Salmon Creek No. 1	347	2,000
Do	Salmon Creek No. 3	441	2,550
Yakima-Sunnyside	Mabton	44	131
Do	Main Canal	54	276
Yakima-Tieton	Lateral E	100	3,410
Yakima-Wapato	Drop 0	24	2,930
Do	Drop 1	40	4,083
Do	Drop 2	32	2,443
Do	Drop 3	34	1,488
Wyoming: Shoshone	Shoshone	200	40,000
Total			1,506,300-1,954,300

[1] Power from irrigation flow only.

[2] Several stages.

ELECTRICAL AND MECHANICAL ENGINEERING.

The following is a general report of the work accomplished by the electrical division of the Denver office during the fiscal year ending June 30, 1916:

Arizona, Salt River project.—The Crosscut power plant near Tempe, Ariz., was completed and the official capacity and efficiency tests were made in January, 1916. In this plant are installed six vertical impulse wheels, each of 1,000-horsepower capacity operating under a head of 117 feet. The water wheels have a guaranteed efficiency of 75 per cent at 1,000-horsepower capacity and under test developed a maximum efficiency of over 79 per cent. All of the difficulties met with in the construction of this plant have been overcome successfully and it is now in continuous and satisfactory operation. So little trouble is encountered in the operation of this plant that a crew of five men, including the chief and one janitor, have no difficulty in operating the plant.

At the Roosevelt power house a connection between the sluicing tunnel and the 7-foot penstock was designed and material purchased. This connection will make it possible to operate units Nos. 1, 2, and 3 on clear water from the reservoir and will make it unnecessary, for the present at least, to repair the power canal and its diversion dam which were seriously damaged in the floods of January, 1916. The two regulating needle valves to be used at the end of the sluicing tunnel in conjunction with this installation were delivered but have not been installed.

The condition of the north outlet at the Roosevelt Dam was given careful study and tentative designs of supplemental valves for the control of this outlet were prepared and submitted to a board of engineers which convened at Roosevelt June 20, 1916.

The installation of the sixth generating unit at the Roosevelt power house with a capacity of 5,000 kv-a. was completed and the unit placed in operation. This raises the capacity of the Roosevelt plant from 5,500 to 10,500 kv-a. The operation of this unit has proven very satisfactory and the addition of this large generator to the system has been very beneficial to the service rendered to various customers receiving power.

Arizona-California, Yuma project.—Preliminary studies of the proposed Yuma Mesa pumping plant operated by power developed at the drop in the main canal were made and estimates of the cost of this system were partially completed. The design of a drainage pumping plant to be operated by internal combustion engines was also under consideration.

Colorado, Grand Valley project.—Electric equipment consisting of a gasoline-driven generator, storage battery, motors, and controllers, for the operation of the rolling crest of the Grand River diversion dam, was purchased and installed. The apparatus is designed to raise the crest at any speed desired by the operator and to safeguard the mechanism by dynamic braking while lowering.

Idaho, Boise project.—The Boise River power plant which has supplied power for the construction of the Arrowrock Dam was leased for a term of five years to the Electric Investment Company of Boise, this lease taking effect July 1, 1916. The 20 balanced valves installed at the Arrowrock Dam have now been in successful operation for two years and inspection of the outlets shows that they are still in perfect condition.

Idaho, Minidoka project.—The Boersch Lake drainage pumping plant, consisting of two 25-second-feet vertical pumps, was completed and placed in operation. The 114 pumping plant near Acequia was installed and placed in operation. This plant has a capacity of 4 second-feet at 9½ feet lift and consists of a centrifugal pump geared to an induction motor. In connection with this plant an outdoor substation consisting of a transformer and switches mounted on a steel tower was installed near the 30,000-volt transmission line at Acequia. A similar substation was installed for delivering a small amount of power to consumers at Marshfield. A contract for delivering power to the town of Albion was consummated and transmission line and substation constructed. The contract for delivery of power to the city of Burley was rewritten and the amount of power to be delivered increased from 1,500 to 2,500 kilowatts. The new contract provides for the installation of 1,200-kilowatt transformer capacity in the Government substation, these transformers to be furnished by the city and paid for in power. Propositions were received from the Mountain States Telephone Co. for the purchase of the project telephone lines and from the Minidoka Mutual Telephone Co. for the lease of the telephone lines north of the river. Both of these propositions were rejected.

Montana, Huntley project.—The capacity of the direct pumping units at the Ballantine pumping plant was increased approximately 10 per cent by the purchase and installation of new turbine runners and gates.

Nevada, Truckee-Carson project.—The third unit installed at the Lahonton power plant by the Canyon Power Co., now operating this plant under lease, was tested and accepted on the part of the Reclamation Service.

New Mexico, Rio Grande project, Elephant Butte storage.—The hydroelectric plant consisting of a 150-kilowatt generator connected to a 225-horsepower spiral-flume turbine was installed and placed in operation. This plant was operated to relieve the steam plant during the latter part of construction and will be used for lighting the dam and supplying various motors required in connection with the operation of the control valves. A metal spraying pistol was leased from the Metals Coating Co. of America and experiments are being made in the repair of erosion by this means. The operation of the balanced valves for the Elephant Butte Dam was studied and tentative designs prepared for the correction of certain difficulties which developed with these outlets. Such difficulties have not yet become of sufficient importance to warrant any change in the present method of operation.

North Dakota, North Dakota pumping project.—Assistance was given in negotiating a revision of the commercial power contract with the city of Williston, and in an attempt to revive the operation of this project for the season of 1916.

Oregon, Klamath project.—The lease of the Keno Canal for power purposes was considered and a draft of specifications prepared and submitted to the project manager for consideration. An estimate of a direct pumping plant for the Pine Grove irrigation district was prepared.

Utah, Strawberry Valley project.—The question of the future operation of the Strawberry Valley power plant was considered at a board meeting on February 12, 1916, and specifications for lease of the plant were prepared and issued.

Washington, Okanogan project.—The power and pumping system for the irrigation of Robinson Flat was tried out and the turbines at the two power plants tested. The turbine at plant No. 1 developed an efficiency considerably in excess of the guaranties, but No. 2 turbine was somewhat deficient in capacity. A new runner has been furnished by the contractor and will be tested during the summer of 1916. A surge pipe has been installed near the Robinson Flat pumping plant to eliminate the effect of water hammer in the long delivery pipe.

Washington, Yakima project, Sunnyside unit.—The Snipes Mountain pumping plant was put in operation at the beginning of the season of 1915, but its operation is not yet entirely satisfactory. Plans and specifications for the Grandview power and pumping plants were prepared and bids were received for all construction work in connection with this project before the end of the fiscal year. No contracts were let, as the irrigation district had not at that time fulfilled the necessary legal requirements. The Outlook direct-pumping plant was placed in operation at the beginning of the irrigation season of 1916, and preliminary efficiency and capacity tests were made.

Wyoming, Shoshone project.—The two balanced valves installed at the Shoshone Dam were tried out for the first time in May, 1916, and operated with entire satisfaction.

General.—The electrical department was transferred from Los Angeles to Denver and consolidated with the office of the chief of construction, July 15, 1915. In addition to the work above outlined, this division has provided inspection for material and equipment purchased in Denver and vicinity. One of the functions of this department is to assist the purchasing department in all electrical or mechanical purchases. It also has general supervision over the operation of the power and pumping plants and the design of mechanical and electrical devices of the service.

CEMENT-TESTING WORK.

The amount of cement for which tests were made during the fiscal year ending June 30, 1916, was 171,213 barrels, of which 168,213 barrels were accepted and 3,000 barrels rejected. The following table shows the number of barrels for which tests have been made, and the amount and per cent accepted, from 1904, when the testing laboratory was opened, to June 30, 1916:

Year.	Amount for which tests were made.	Accepted.	
		Amount.	Per cent.
	Barrels.	*Barrels.*	
Jan. 1, 1904, to June 30, 1906	160,044	146,602	91.6
Year ending June 30, 1907	197,321	191,204	96.9
Year ending June 30, 1908	147,554	137,526	93.2
Year ending June 30, 1909	196,097	163,733	83.5
Year ending June 30, 1910	140,293	127,743	91.1
Year ending June 30, 1911	93,986	88,986	94.6
Year ending June 30, 1912	160,553	149,303	92.9
Year ending June 30, 1913	181,653	170,473	93.8
Year ending June 30, 1914	404,885	391,135	96.6
Year ending June 30, 1915	602,288	583,588	96.9
Year ending June 30, 1916	171,213	168,213	98.2
Total	2,455,887	2,318,506	94.4

All cement purchased during the fiscal year ending June 30, 1916, has been purchased under the United States Government specifications for Portland cement issued under date of May 1, 1912, and the methods of testing employed in the laboratory have been in accordance with those provided for in these specifications. In the appendix will be found a table giving the average results of all tests on accepted cement from January 1, 1904, to June 30, 1916.

Regular sets of long-time tests have been continued, and occasional chemical analyses have been made as a matter of record on all brands under test. Other general work has included tests on samples of concrete aggregates from various projects; water analyses for various projects; inspection of drain-tile shipments; and miscellaneous tests and analyses as required. In connection with the long-time tests, compressive tests have been added to the tensile tests of which those have heretofore consisted.

The laboratory has cooperated during the year with the United States Bureau of Standards in starting a series of field experiments in connection with the investigation of the action of alkali on cement concrete. This has consisted of the manufacture of large-sized specimens of concrete, both from standard materials at the laboratory and from field materials available at several of the projects, and the exposure of the specimens for test at various points on those projects where alkali conditions prevail.

LEGAL DIVISION.

The chief counsel of the Reclamation Service has charge of the work of the service affecting its legal side. In this are involved litigation, the initiation and protection of water rights, the making of contracts, the purchase of lands, the withdrawal of lands from entry and their restoration; also many questions affecting entries, farm units, etc.

Besides the Washington office, there are nine offices in the field—a central office in Denver and eight others distributed somewhat in accordance with the geographic divisions into which the work of the service is divided.

The force consists of attorneys, clerks, and stenographers, being a total of about 47 persons, some of them being temporarily employed for special work.

During the fiscal year 1916 there were 65 lawsuits affecting the interests of the service, involving a total of about $3,000,000 where a money consideration was given, while several times that amount was involved in other cases of water-right adjudications, injunctions, etc. The immediate supervision of these suits is in the Department of Justice, but the legal division of the service devotes a large part of its time to the preparation of these cases under the personal direction of the chief counsel.

About 1,750 contracts were executed during the fiscal year, involving about $4,000,000.

A large part of the correspondence in the field is handled by or through the district counsel, while most of the correspondence in the Washington office is passed upon and handled by the legal division, for the reason that legal considerations are involved in the large majority of matters considered.

During the fiscal year an investigation of the irrigation possibilities on Green River and its tributaries in Wyoming was undertaken in cooperation with the State of Wyoming. This involved the careful study of the water rights in this drainage area, and in view of the importance of the subject this investigation as regards the existing and possible water-right claims has been extended to the entire basin of Colorado River, and a force of 10 or 12 attorneys and assistants has been engaged during the greater part of the fiscal year in examining and digesting the official records of the 7 States in which the Colorado River drainage basin lies, and also in making a careful study of the legal questions involved.

This investigation is one of the most important which the service has taken up, as the Colorado drainage area covers a very large proportion of the irrigated section of the country, and the local, interstate, and international questions which must be solved in the proper utilization of its waters are of far-reaching effect.

The chief counsel is the legal adviser of the Secretary in all matters relating to the work of the Reclamation Service and in special cases involving irrigation questions.

CONTRACTS UNDER WARREN ACT.

[Feb. 21, 1911, 36 Stat., 925.]

BOISE PROJECT, IDAHO.

Name of contractor.	Date of contract.	Amount of water in acre-feet.
Farmers Cooperative Ditch Co	Aug. 10, 1915	1,200
Farmers Union Ditch Co.	July 23, 1915	2,610
Josephine Gallaher	Aug. 16, 1915	20
Nampa-Meridian Irrigation District	Aug. 12, 1915	4,300
Pioneer Irrigation District	July 27, 1915	5,000
Settlers' Irrigation District	do	1,800
South Boise Mutual Irrigation Co	Aug. 12, 1915	290
Riverside Irrigation Co.	July 28, 1915	2,001.27
Do	Aug. 17, 1915	
New York Canal Co	July 23, 1915	8,757.81
Do	Aug. 11, 1915	

MINIDOKA PROJECT, IDAHO—JACKSON LAKE ENLARGEMENT.

Name of contractor.	Date of contract.	Amount of water in acre-feet.
Kuhn Irrigation & Canal Co. and Twin Falls Canal Co	Feb. 25, 1913	409,000

NORTH PLATTE PROJECT, NEBRASKA-WYOMING

PERMANENT WATER SUPPLY.

Name.	Date.	Amount of water in acre-feet.
Tri-State Land Co. (succeeded by Farmers' Irrigation District)	Aug. 20, 1912 Nov. 20, 1912 Dec. 6, 1912 Aug. 31, 1915	100,000
Gering Irrigation District	Jan. 17, 1913 Aug. 4, 1914	20,000
Central Irrigation District	Mar. 6, 1913 Aug. 4, 1914	2,455
Chimney Rock Irrigation Canal & Water Power Co	Mar. 6, 1913 Aug. 6, 1914	6,580
Beerline Irrigation Canal Co	Mar. 6, 1913	2,050
Browns Creek Irrigation District	July 14, 1913 Aug. 4, 1914	12,380
Bridgeport Irrigation District	June 14, 1915	15,524
Pleasant Valley Lateral Association	June 16, 1915	6,573.6
Goshen Land Co	July 1, 1915	18,652

TEMPORARY WATER SUPPLY.

Dawson County Irrigation Co	June 1, 1916	[1] 1,000

[1] With optional increase; 3,000 acre-feet delivered during fiscal year 1916.

RIO GRANDE PROJECT, NEW MEXICO-TEXAS.

Lee Moor	Mar. 3, 1916	1,000

YAKIMA PROJECT, WASHINGTON.

Name of contractor.	Date of contract.	Amount of water in acre-feet.
W. O. Bradbury	May 22, 1916	54
Grandview Irrigation District	[1] Aug. 4, 1916	....
Granger Irrigation District	(2)	....
Kittitas Reclamation District	Jan. 18, 1913	210,000
W. Moeller	(2)	....
Outlook Irrigation District	Nov. 23, 1914	[3] 11,620
Pomona Heights Irrigation District	(2)	....
Snipes Mountain Irrigation District	Nov. 16, 1914	5,265
Sunnyside Irrigation District	Oct. 6, 1914	18,520
Union Gap Irrigation District	Mar. 2, 1915	4,222

[1] Not complete.
[2] Under consideration.
[3] This will be changed under amended contract.

LITIGATION.

The following table shows the general progress of litigation during the fiscal year:

Number of cases pending at beginning of year	48
Number of cases initiated during the year	17
Total	65
Number of cases disposed of during the year	17
Number of cases pending at the end of the year	48

LEGISLATION.

Legislation affecting the Reclamation Service since the last annual report includes the following:

The act approved May 8, 1916 (Public, No. 72), making provision in regard to the validation of certain class of entries on lands withdrawn under the second form;

The appropriation act approved July 1, 1916 (Public, No. 132);

The act approved July 26, 1916 (Public, No. 167), which provides for acceptance of the provisions of the reclamation extension act of August 13, 1914, under certain conditions.

Copies of these acts will be found in the appendix.

DECISIONS OF THE SECRETARY OF THE INTERIOR.

A digest of important decisions which have been rendered by the Secretary of the Interior during the fiscal year will be found in the appendix. Among them are, also, a few important decisions by the Comptroller of the Treasury.

PUBLIC NOTICES AND ORDERS.

Copies of the public notices and orders issued by the Secretary in regard to reclamation payments, etc., during the fiscal year will be found under the respective projects. The following order relating to all projects was issued on March 16, 1916:

Whereas under the terms of certain public notices and orders issued prior to the passage of the act of August 13, 1914 (38 Stat., 686), the charges for operation and maintenance accrued and accumulated against the irrigable lands with requirement for payment of the same at the time of filing of water-right applications; and

Whereas the charges which thus accrued have in some cases made a very heavy charge for the prospective water user to pay in addition to the installment of construction charges; and

Whereas it is for the interest of the United States that accrued and accumulated charges in such cases shall be added to the construction charges: Now, therefore,

It is ordered, 1. That all charges for operation and maintenance which accrued and accumulated on or prior to December 1, 1914, against lands for which water-right applications have not been filed, shall be added to the construction charges so that water-right applications may be made for such lands without obligation to pay the total amount of such charges at the time of filing water-right application; provided that such water-right application is made under said act of August 13, 1914.

2. The provisions of this order shall apply to all projects under which the operation and maintenance charges were regarded as accumulating prior to August 13, 1914, but shall not apply to any lands for which water-right application has been made.

PURCHASES OF RIGHTS AND PROPERTY.

A statement of the transactions for the acquisition of rights and property is given in the appendix.

PURCHASE AND TRANSPORTATION OF MATERIALS.

In order to secure the highest practical economy and bring about uniformity in methods it has been found desirable to make most of the purchases through a central office located as near as possible to the principal manufacturing and jobbing districts, and also near the center of transportation facilities. For this reason an office was maintained for a number of years in the Federal Building, Chicago, Ill., with facilities for advertising and purchasing supplies and for forwarding these on the most economical and expeditious routes. On June 1, 1915, a general western headquarters office was established in Denver, Colo., and it was deemed best to consolidate all detached offices at that point; the Chicago purchasing force was accordingly moved to Denver and purchases handled from that point after that date. It was considered that better service could be afforded the projects in handling purchases from the Denver office, as the chief electrical engineer, drainage engineer, mechanical engineer, and technical engineer were located there, and these men could personally supervise the drawing of specifications covering purchases under their respective lines.

The total number of purchases of supplies for the field during the past year was 5,049, with a total value of $680,601.99. The cash discount received by prompt payment of bills ran from one-half to 5 per cent and amounted to $6,747.38. The purchasing section also effected 504 transfers of equipment, machinery, material, etc., between projects, amounting to $85,063.35. A total of 5,398 Government bills of lading was issued, covering the movement of 24,769 tons of freight. The following table gives available data covering purchases made by the purchasing office:

Fiscal year.	Number purchases.	Gross amount.	Discount.
1910	1,774	$504,023.60	....
1911	1,607	574,323.74	....
1912	2,205	930,018.53	....
1913	2,735	459,890.17	$4,286.29
1914	3,116	471,446.28	4,604.28
1915	2,854	454,661.46	3,842.09
1916	5,049	680,601.99	6,747.38
Total	19,340	4,074,965.77	19,480.04

On July 1, 1915, the unsettled bills for freight and express charges amounted to $199,819.86. There were received during the fiscal year for administrative examination new bills amounting to $424,354.01; bills amounting to $494,422.64 were examined and basis for settlement was arranged with claimants, leaving outstanding on June 30, 1916, bills to the amount of $129,751.23. The commercial charges on bills settled would have amounted to $676,110.63.

During the fiscal year there were filed with the various transportation companies claims amounting to $22,212.45 on copies of expense bills covering shipments consigned to contractors which, as paid, are covered into the reclamation fund.

The following table gives general data regarding freight and express charges since 1906:

Year.	Bills settled.	Commercial charges.	Deducted account of contractors' land grant and other causes.	
			Total.	Per cent.
1906-7	$278,782.10	$470,863.26	$192,081.16	40.8
1907-8	369,583.04	577,830.42	208,247.38	36.0
1908-9	778,047.12	1,403,970.10	625,922.98	44.5
1909-10	437,032.61	758,808.76	321,776.15	42.4
1910-11	405,360.55	666,876.59	261,516.04	39.2
1911-12	610,740.23	1,055,733.27	444,993.04	42.1
1912-13	481,118.91	837,077.59	355,958.68	42.5
1913-14	547,705.99	927,163.49	379,457.50	40.9
1914-15	778,893.33	1,393,347.96	614,454.63	44.1
1915-16	475,072.36	675,110.63	200,038.27	42.1
Total	5,162,336.24	8,766,782.07	3,604,445.83	41.1

FINANCES.

The financial condition of the service may be summed up in the following condensed statement of total receipts and expenditures. The details of these expenditures are given in the appendix.

The statement of cash receipts and payments appearing below shows that—

At the beginning of the fiscal year there were $2,198,769.44 cash on hand.

During the year this amount was augmented by receipts from various sources to a grand total of $9,064,538.88.

Of the twenty millions authorized by the act of June 25, 1910 (36 Stat., 855), three and one-half millions were transferred to the reclamation fund.

Cash expenditures during the fiscal year were $8,805,940.21.

Town-site receipts transferred to the credit of projects were $21,189.28.

The balance on hand at the close of the fiscal year amounted to $2,436,178.83.

By the processes of the General Land Office and the Treasury Department the receipts from sales of public lands are held in the Treasury from six to nine months before they are placed to the credit of the reclamation fund. Estimated receipts from the sale of public lands in the hands of the Treasury Department on June 30, 1916, which had not been credited to the reclamation fund amounted to approximately $1,700,000.

The reclamation fund, which comprises the moneys received from the sale of public lands, has now reached the total of $88,964,431.51, and from the sale of town sites $301,913.32.

Transfer vouchers, adjusting accounts between the projects for the transfer of the value of services and equipment, amounted to $545,462.58 during the fiscal year 1916. Since the beginning of the service the value of the transfers of supplies, materials, equipment, and services between projects has amounted to $5,552,221.95. This system of transfers between projects has enabled the service to utilize equipment, materials, supplies, etc., to their fullest extent where needed and to charge the cost where the benefit accrued.

CASH TRANSACTIONS.

Below is shown, in the statement of cash receipts and payments, a summation of the cash transactions during the fiscal year 1916:

Statement of cash receipts and payments, fiscal year 1916.

RECEIPTS.

On hand July 1, 1914 (fourteenth annual report, p. 39)		$2, 198, 769. 44
Original receipts:		
Public land sales	$3, 049, 938. 25	
Town-site sales	21, 189. 28	
Bond loan	3, 500, 000. 00	
		6, 571, 127. 53
Repayment water-right charges		964, 207. 81
Miscellaneous receipts		1, 406, 000. 25
Collections in project offices not classified		123, 346. 36
		11, 263, 451. 39

PAYMENTS.

From reclamation fund	$5, 305, 940. 21	
Bond loan	3, 500, 000. 00	
		8, 805, 940. 21
Town-site receipts transferred to credit of projects		21, 189. 28
Balance on hand to June 30, 1916:		
In Treasury	1, 710, 477. 00	
In depositaries to credit of special fiscal agents	602, 498. 54	
In project offices awaiting remittances	123, 346. 36	
		2, 436, 321. 90
		11, 263, 451. 39

ASSETS, LIABILITIES, RESERVES, AND CAPITAL.

Below is presented a combined statement of the assets and liabilities, together with the reserves and capital, of the Reclamation Service as of June 30, 1916. This statement shows that the cash resources on June 30, 1916, were $8,636,321.90, and that all other resources, exclusive of the net expenditure for construction and deferred operation and maintenance charges, amounted to $26,104,549.54. This includes the unaccrued construction charges on contracts with water-right applicants, amounting to $23,025,938.28, as well as the estimated unearned value of construction work contracted, amounting to $649,279.82 on June 30, 1916. This latter amount is offset by a contra entry under contingent obligations, as the payment thereof is contingent upon the contractors fulfilling their contracts with the service. The gross expenditures for construction work in process amount to $116,133,251.08, comprising the cost of irrigation works as shown in the statement of construction cost by functional features. From the gross expenditures is deducted all revenue earned during construction to June 30, 1916, amounting to $6,099,232.01, making the net cost of the construction work in process $110,034,019.07. The deferred operation and maintenance charges amount in all to $1,695,593.03. The grand total of assets is therefore $146,470,483.54. The liabilities of the service amount in all to $2,173,552.93. The reserves for repayment to the reclamation fund of the cost of the projects amount in all to $32,305,197.33. This contains not only the value of construction contracts with water-right applicants for the original acreage subscribed, but also the acreage on which charges have been temporarily suspended on account of the land becoming waterlogged or temporarily unfit for cultivation by reason of alkali, etc. It also comprises the charges accrued on contracts with the Indian Service and those paid by the Kuhn Irrigation & Canal Co. and the Twin Falls Canal Co. for the construction of the Jackson Lake enlargement work. In addition it includes the amount forfeited, penalties paid, and the construction charges paid in advance by water-right applicants. The latter includes the sum of $714,777.37, which amount covers construction work performed by the Salt River Valley Water Users' Association under contract with the United States for the construction of power plants and canals. It also includes the sum of $52,269, representing credits allowed canal companies and others for canal systems taken over by the Government, both of which are included in the gross construction cost of that project. The capital of the service is represented by the actual receipts from the sale of public lands, amounting in all to $88,964,431.61, plus the estimated amount of $1,700,000, now with the Treasury which has not yet been audited and placed to the credit of the reclamation fund. To this is added the $1,000,000 special appropriation for the Rio Grande Dam (34 Stat., 1357) and the $20,000,000 bond loan authorized by the act of June 25, 1910 (36 Stat., 835), the total capital to June 30, 1916, being $111,943,230.18, plus the net amount of moneys received from the Indian Service for work performed on projects in Montana, $278,798.57. This added to the reserves and liabilities equals the amount shown above as the assets.

Combined statement of assets, liabilities, reserves, and capital to June 30, 1916.

ASSETS.

I. Cash:		
With Treasurer United States	$1,710,477.00	
With depositaries to credit of special fiscal agents	602,498.54	
Balance of bond loan available for transfer to reclamation fund, act of June 25, 1910 (36 Stat., 835)	4,500,000.00	
Estimated receipts from sales of public land with Treasurer United States, not yet audited	1,700,000.00	
		$8,512,975.54
II. Collections returnable to fund through Treasury:		
In fiscal agents' possession awaiting remittance	182.21	
In other employees' hands awaiting transfer to fiscal agents	1,487.48	
Cash in special deposit account	121,676.67	
		123,346.36

III. Accounts receivable:			
Construction charges due and uncollected from water-right applicants		$489,939.54	
Construction charges unaccrued on contracts with water-right applicants		23,025,938.28	
Operation and maintenance charges due and uncollected from water-right applicants		311,708.89	
Uncollected freight refunds		16,016.47	
Uncollected water rentals		195,323.70	
Uncollected miscellaneous rentals		44,416.15	
Uncollected miscellaneous items		174,825.20	
			$24,258,168.23
IV. Inventories:			
Miscellaneous stores, stock on hand		805,006.14	
Materials and supplies on hand in storehouses		358,658.61	
Goods in transit		18,886.34	
Unadjusted transfers between projects		14,070.83	
Undistributed cost (freight and handling on inventory property)		479.57	
			1,197,101.49
V. Construction work contracted:			
Unearned value of construction work contracted		595,979.82	
Estimated engineers' expenses on construction work contracted		53,300.00	
			649,279.82
VI. Construction work in process:			
Gross cost of construction of projects to date		107,834,689.97	
Gross supplemental construction cost of projects to date		1,808,809.81	
Gross operation and maintenance cost during construction		4,928,304.51	
Gross cost of producing commercial power during construction		567,510.78	
Plant accounts		939,936.01	
		116,133,251.08	
Less revenues earned during construction as follows:			
Rentals of buildings	$157,978.70		
Rentals of grazing lands	170,881.49		
Rentals of power and light	932,007.76		
Rentals of irrigation water	3,185,668.11		
Rentals of telephone	13,651.47		
Miscellaneous revenues	177,098.91		
Receipts from sale of townsite lots	283,621.93		
Contractors' freight refunds	202,779.65		
Forfeitures by defaulting bidders and contractors	115,764.47		
Less cost adjustments—			
Profits on mess house operations	140,517.50		
Profits on mercantile store operations	340,511.09		
Profits on hospital operations	19,510.98		
Loss on operation of railroads	[1] 3,849.73		
	5,736,142.33		
Amount set up as reserves or depreciations charged to cost and not expended	363,089.68		
		6,099,232.01	
Net cost of construction of projects to date			110,034,019.07
Deferred operation and maintenance charges			1,695,593.03
Total assets			146,470,483.54

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[1] Deduct.

LIABILITIES, RESERVES, AND CAPITAL.

VII. Accounts payable:			
Unpaid labor		$290,175.47	
Unpaid purchases		233,764.67	
Unpaid progress earnings under construction contracts		216,121.96	
Unpaid contract holdbacks		95,218.30	
Unpaid freight and express charges		224,797.64	
Unpaid passenger fares		8,391.85	
Unpaid agreements to purchase real property		38,589.08	
Unredeemed coupon books		3,215.00	
Unredeemed meal tickets		3,919.40	
Unpaid miscellaneous		192,417.67	
Unadjusted transfers from other projects		102,413.57	
Guaranty and special deposits		115,257.50	
			$1,524,272.11
VIII. Contingent obligations:			
Unearned value of construction work contracted		595,979.82	
Estimated engineering expenses on construction work contracted		53,500.00	
			649,279.82
IX. Reserves for repayment to reclamation fund of cost of projects:			
Value of construction contracts with water-right applicants		26,389,526.51	
Value of construction contracts with water-right applicants temporarily suspended		931,471.13	
Construction charges paid in advance by water-right applicants		1,011,013.27	
Construction charges paid and forfeited by water-right applicants		30,583.94	
Penalties paid on construction charges by water-right applicants		20,837.18	
Miscellaneous items—			
Construction charges accrued on contracts with Indian Service		3,094,149.68	
Construction charges paid on Jackson Lake enlargement work		827,615.62	
			32,305,197.33
X. Capital:			
Reclamation fund	$89,266,344.83		
Less town-site receipts transferred to credit of projects	301,913.22		
		88,964,431.61	
Rio Grande Dam appropriation (34 Stat., 1357)		1,000,000.00	
Bond loan (36 Stat., 835)		20,000,000.00	
Estimated reclamation fund with Treasurer United States, not yet audited		1,700,000.00	
Indian moneys spent by Reclamation Service during year taken into the account as shown by tables		278,798.57	
			111,943,230.18
Revenues in excess of cost of operation and maintenance			48,504.10
Total liabilities, reserves, and capital investment of the Government			146,470,483.54

CONSTRUCTION COSTS BY FEATURES.

The statement which follows gives by features the cost of the construction of all storage works, canal systems, lateral systems, drainage and other protection systems, power systems, and other construction accounts of all projects, including the Blackfeet, Flathead, and Fort Peck Indian projects.

Feature cost of all projects to June 30, 1916.

Examination and surveys	$3,213,244.07	
Storage works	31,444,241.50	
Pumping for irrigation	831,645.27	
Canal system	42,779,107.78	
Lateral system	17,478,605.36	
Drainage system	2,328,389.00	
Flood protection	2,478,214.59	
Power system	5,568,526.41	
Farm units	414,814.59	
Permanent improvements and lands	2,507,081.29	
Telephone system	440,946.65	
Operation and maintenance during construction (water rental basis)	5,536,091.28	
Plant accounts	925,019.94	
Operation and maintenance charges transferred to and compounded with construction charges	187,323.35	
		$116,133,251.08
Less revenues earned during construction period:		
Rental of buildings	158,752.00	
Rental of grazing and farming lands	170,881.49	
Rentals of power and light	932,007.76	
Rentals of irrigation water	3,185,668.11	
Rentals of telephones and tolls	13,651.47	
Contractors' freight refunds	202,779.65	
Forfeitures by defaulting bidders and contractors	115,764.47	
Sale of town-site lots	282,810.71	
Other revenues, unclassified	164,090.12	
Profit on mess-house operations	140,517.50	
Profit on mercantile store operations	340,511.09	
Profit on hospital operations	19,510.98	
Loss on railroad operations	[1] 3,849.73	
Other profits on operations, unclassified	13,046.71	
Plant accounts	363,089.68	
Total revenues		6,099,232.01
Net cost of construction to June 30, 1916		110,034,019.07

OPERATING REVENUES AND EXPENSES.

There follows a combined statement giving the revenues and expenses for the operation of projects which have been opened by public notices of the Secretary of the Interior. These revenues and expenditures are those resulting from operations connected with the lands thrown open to water-right applicants by these public notices and do not include the transactions resulting from the temporary operation of canals during the construction period.

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[1] Deduct.

Combined statement of operating revenues and expenses to June 30, 1916.

EXPENSES.

Storage works:		
Operation	$176, 110. 60	
Maintenance	234, 335. 06	
Total		$410, 445. 66
Pumping for irrigation:		
Operation	343, 837. 57	
Maintenance	45, 444. 74	
Total		473, 373. 39
Canal system:		
Operation	438, 617. 79	
Maintenance	859, 548. 81	
Total		1, 298, 166. 60
Lateral system:		
Operation	850, 417. 20	
Maintenance	1, 680, 888. 64	
Total		2, 531, 305. 84
Drainage system:		
Operation	27, 468. 07	
Maintenance	109, 751. 79	
Total		137, 219. 86
Flood-protection system:		
Operation	148. 56	
Maintenance	13, 148. 69	
Total		13, 297. 25
Undistributed expenses:		
Operation	146, 550. 19	
Maintenance	316, 295. 80	
Total		462, 845. 99
Supplemental construction chargeable to operation and maintenance:		
Cost to Aug. 31, 1914	60, 421. 74	
Cost since Sept. 1, 1914	8, 450. 62	
Total		68, 872. 36
Commercial power operation		87, 684. 59
Revenues in excess of operation and maintenance		48, 504. 10
Grand total		5, 531, 715. 64

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	$2, 848, 679. 96
Operation and maintenance charges paid in advance by water-right applicants	10, 458. 04
Operation and maintenance charges paid and forfeited by water-right applicants	10, 455. 08
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	12, 420. 12
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	11, 835. 97
Rental of land and buildings during operating period	28, 442. 75
Rentals of grazing and farming lands during operating period	16, 808. 95
Rentals of power and light during operating period	195, 194. 18
Rentals of irrigation water	326, 511. 72

Rental of telephone and tolls during operating period	$557.75
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	269,064.76
Other revenues, unclassified, earned during operating period	129,366.02
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	1,695,592.28
Total	5,531,715.64

REPAYMENT CONTRACTS.

The development of the projects has resulted in water-right applications or contracts that have been entered into with settlers, providing for repayment to the Government of the cost of constructing the works for irrigating their lands. These contracts, under provisions of the original reclamation law, require complete repayment of construction charges in 10 annual installments, but the reclamation extension act gives such of those as accept its terms and to those who had not executed the 10-year contracts the right to repay in 20 years in annual installments, so graduated as to place upon the irrigator a minimum burden during the early years of farm development. On 19 projects the lands have been opened to entry and settlement and the construction charges fixed by public notice. Contracts with water-right applicants for repayment to the reclamation fund of the cost of projects total $27,320,997.64. Of this amount there has been collected $4,146,630.35 of the charges, leaving the unpaid value of these contracts on June 30, 1916, $23,174,367.29.

There are still large acreages of land on most of the projects to which the service is now ready to furnish irrigation water and which are being taken up from day to day and new contracts signed. On all the projects the present net investment of the Government exceeds the asset value of the contracts. When all of the lands susceptible of irrigation are covered by contracts, the value of the contracts on any project should equal the amount of the total investment thereon. It is to be noted in this connection, however, that on several of the projects additional investment will be necessary to make all of the lands irrigable.

ESTIMATED COST OF CONTEMPLATED WORK.

It is estimated that there will be expended during the fiscal year 1917 the sum of $10,957,290.05. The following table gives the tentative distribution of this amount to the various functional features of all projects, including the Blackfeet, Flathead, and Fort Peck Indian projects. The details are given under a similar heading for each project.

Estimated cost of contemplated work on all projects during fiscal year 1917.

Examination and surveys	$891,270.07
Storage systems	1,165,105.00
Pumping for irrigation	125,200.00
Canal systems	2,532,476.85
Lateral systems	2,093,994.06

Drainage systems	$1,127,879.54
Flood protection	285,000.00
Power systems	5,500.00
Farm units	65,457.78
Permanent improvements and lands	265,019.50
Telephone systems	32,530.00
Operation and maintenance:	
During construction (water-rental basis)	1,120,616.19
Under public notice	1,005,412.56
Stores and other operations	241,828.50
Total	10,957,290.05

GENERAL FINANCIAL DATA FOR ALL PROJECTS.

The following statement shows general financial data for all projects:

Estimated cost of completed projects		$174,844,433.44
Total construction cost to June 30, 1916		109,885,690.43
Appropriation for fiscal year 1917, total		11,410,423.95
Allotment for construction, fiscal year 1917		8,271,248.05
Appropriation fiscal year 1916		13,780,000.00
Increase under 10 per cent provision of act		208,657.41
Total appropriation		13,988,657.41
Expenditures during fiscal year chargeable to 1916 appropriation:		
Disbursements	$6,819,633.89	
Transfers	448,150.43	
	7,267,784.32	
Registered liabilities chargeable to 1916 appropriation	982,245.08	
Contract obligations wholly covered by 1916 appropriation	271,800.91	
Estimated engineering expense on contract work wholly covered by 1916 appropriation	24,100.00	
		8,545,930.31
Unencumbered balance July 1, 1916		5,442,727.10

Repayments:	
Construction charges—	
Accrued to June 30, 1916	4,158,121.58
Collected to June 30, 1916	3,668,182.04
Uncollected	489,939.54
Operation and maintenance charges (public notice)—	
Accrued to June 30, 1916	2,847,767.00
Collected to June 30, 1916	2,536,058.11
Uncollected to June 30, 1916	311,708.89
Water-rental charges—	
Accrued to June 30, 1916	3,460,518.03
Collected to June 30, 1916	3,265,194.33
Uncollected to June 30, 1916	195,323.70
Power earnings—	
Accrued to June 30, 1916	1,121,444.02
Collected to June 30, 1916	1,079,294.90
Uncollected June 30, 1916	42,149.12

COST OF INVESTING THE RECLAMATION FUND.

In the thirteenth annual report there was for the first time presented a statement of the general expenses by calendar years showing the gross expenditures and the ratio of the general expense thereto. The figures shown for general expense were estimates based on partial returns from an investigation instituted to determine the ratio of general expense to all other expenditures. These accounts, as presented in the thirteenth annual report, had been kept by calendar years, but owing to the change of policy involving annual appropriations by fiscal years, a readjustment of these accounts was immediately undertaken.

There is presented herewith a statement showing by fiscal years the actual gross expenditures from the reclamation fund and the actual total amount of general expense, together with the ratio of general to all other expenditures. The results shown by this table differ somewhat from those given in the table of estimates presented in the thirteenth annual report. By reference to the table which follows it will be found that the average cost of investing $100 in the construction and maintenance of the permanent works of the Reclamation Service has been $8.58 during the past 14 fiscal years.

Statement showing, by fiscal years, the gross expenditures from the reclamation fund less general expense, the total amount of general expenses of the service, and the ratio of general expenses to all other expenditures.

Fiscal year.	Gross expenditures exclusive of general expense.	General expense.	Ratio of general to all other expenditures.
1903	$245,548.27	$23,546.20	9.59
1904	1,395,178.17	118,253.05	8.48
1905	3,450,812.79	319,384.44	9.25
1906	7,007,285.71	546,237.15	7.79
1907	12,188,889.67	755,164.91	6.19
1908	11,358,174.72	792,970.33	6.98
1909	10,037,536.09	887,484.08	8.84
1910	9,543,060.87	873,496.00	9.15
1911	9,100,885.25	897,501.27	9.86
1912	11,316,314.42	892,565.41	7.89
1913	8,507,467.36	958,443.72	11.27
1914	10,055,187.91	1,002,333.39	9.97
1915	14,583,178.54	1,058,809.24	7.26
1916	10,110,983.77	1,077,485.42	10.65
Total	118,900,503.54	10,203,674.61	8.58

PERSONNEL.

On June 30, 1916, the force of the Reclamation Service comprised 5,410 persons, subdivided as follows: Educational, 507; noneducational, 1,154; laborers, 3,749. In addition the employees of contractors working on reclamation projects numbered 672. A more detailed statement, giving the administrative personnel of the service and the number of employees by projects, classified as above, will be found in the appendix.

Injuries to employees.—Under the terms of the compensation act of May 30, 1908, 391 injuries to employees were reported during the calendar year 1915, the corresponding figure for 1914 being 635. In 1915 claims for compensation were allowed in 250 of the cases of reported injury, or 63.9 per cent, and in 1914 in 403 cases, or 63.4 per cent. The average compensation paid for injuries received in 1914 amounted to $145.93, as compared with $168.28 in 1913. Payments have not been completed for injuries received in 1915. Further detailed statistics showing the number of injuries reported, claims allowed, and compensation paid, by projects, since 1908, will be found in the appendix.

Medical care of employees.—On practically all the projects the services of local physicians have been utilized; payment for their services has been made from the hospital fund accumulated through deductions of $1 a month from the pay of employees. Contract physicians have been employed on the Salt River and Grand Valley projects and on the storage unit of the Yakima project. Civil-service physicians have been employed on the Milk River project and on the Jackson Lake enlargement work. The large hospitals at Arrowrock and Elephant Butte, which have been in operation for several years in connection with the construction of the Arrowrock and Elephant Butte dams, have been dismantled.

As stated in previous reports the present policy of the service contemplates discontinuing the employment of civil-service and contract physicians as rapidly as practicable and utilizing the services of local physicians and local hospitals entirely.

Inoculation with typhoid prophylactic.—During the fiscal year the service continued, in cooperation with the War Department, the use of typhoid prophylactic among the field force. Over 400 complete treatments, consisting of an initial injection of 500,000,000 bacteria and two succeeding injections of 1,000,000,000 bacteria each, have been sent to the field, making a total since July, 1912, of about 2,800 treatments. Reaction reports have been received from 1,104 cases. During the fiscal year such reports were received from 125 cases which are summarized in the accompanying table:

	Number patients.	Reaction.			
		Absent.	Mild.	Moderate.	Severe.
First dose	125	74	44	7	....
Second dose	117	79	35	3	....
Third dose	112	89	22	1	....
Per cent:					
First dose	100	59.2	35.2	5.6	....
Second dose	100	67.5	29.9	2.6	....
Third dose	100	79.5	19.7	.8	....

As noted in previous reports, the slight degree of discomfort accompanying the inoculations is indicated by the fact that following the first inoculation the reactions were either absent entirely or mild in character in 94.4 per cent of the cases, after the second inoculation in 97.4 per cent, and after the third inoculation in 99.2 per cent. No severe reactions were recorded.

Of the 125 employees receiving the treatment, 112 received the full treatment of three inoculations, 5 received only two inoculations, and 8 only one.

DISCUSSION OF PROJECTS.

PRIMARY PROJECTS.

(For detailed tables on cement, unit bids and contract prices, engineering data for projects on completion, summary of results to June 30, 1916, crops and operation and maintenance data, finances, etc., see appendix.)

ARIZONA, SALT RIVER PROJECT.

WILLIAM S. CONE, project manager, Phoenix, Ariz.

LOCATION.

Counties: Maricopa and Gila.

Townships: 2 S. to 3 N., Rs. 1 to 6 E. and 1 W., and Tps. 3 to 5 N., Rs. 11 to 14 E., Gila and Salt River base and meridian.

Railroads: Santa Fe, Prescott & Phoenix; Arizona Eastern.

Railroad stations and other towns, showing estimated population January 1, 1916: Phoenix, 23,600; Mesa, 3,000; Glendale, 1,200; Tempe, 2,000; Chandler, 600; Peoria, 300; Gilbert, 50; Scottsdale, 50; Higley, Lehi, Tolleson, Alhambra, Cashion, and Laveen, each about 25.

WATER SUPPLY.

Source of water supply: Salt and Verde Rivers and wells in various parts of the valley.

Area of drainage basins at Granite Reef Dam: Salt River, 6,250 square miles; Verde River, 6,000 square miles.

Annual run-off in acre-feet: Salt River at Roosevelt (5,760 square miles), 1889 to 1915, maximum 3,226,000, minimum 153,394, mean 802,049; Verde River at McDowell (6,000 square miles), 1889 to 1915, maximum 1,822,000, minimum 116,679, mean 544,891.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which service is prepared to supply water, season of 1916: 191,647.6 acres, consisting of 183,233.6 acres of private, homestead, and school lands contracted with the Water Users' Association, and 8,414 acres included within town sites.

Area under rental contracts, season of 1916: 189,873 acres (on June 30, 1916).

Length of irrigating season: 365 days, October 1 to September 30.

Rainfall on irrigable area: Thirty-one-year period, average, approximately 8 inches. Calendar year 1915, 9.41 inches.

Average elevation of irrigable area: 1,200 feet above sea level.

Range of temperature on irrigable area: 22° to 117° F.

Character of soil of irrigable area: Sandy loam, with clay in places.

Principal products: Alfalfa, grain, cotton, olives, citrus and deciduous fruits, and live stock.

Principal markets: Phoenix and other Arizona towns, Pacific coast cities, and eastern markets.

LANDS OPENED FOR IRRIGATION.

No lands have been opened for irrigation by public notice. All lands are being irrigated under rental contracts.

CHRONOLOGICAL SUMMARY.

Reconnoissance made and preliminary surveys begun: 1902.
Construction recommended by the director: March 7, 1903.
Construction conditionally authorized by the Secretary: March 14, 1903.
Grand, Water Power, Salt River Valley, Maricopa, and Joint Head Canals purchased: June 15, 1906.
Intake Dam for Power Canal completed: October, 1906.
Power Canal completed: October, 1906.
Irrigation by the Reclamation Service begun: May 15, 1907.
Granite Reef Dam completed: August, 1908.
South Canal completed: June, 1909.
Eastern Canal completed: December, 1909.
Roosevelt Dam completed: February 5, 1911; formal dedication, March 18, 1911.
San Francisco pumping plant completed: October, 1911.
South-Consolidated power plant, operation commenced: October 23, 1912.
Arizona Falls power plant, operation commenced: May, 1913.
Western Canal completed and operation commenced: February 16, 1913.
Mesa District pumping plants (Batteries A, B, C, D, E, F), drilling commenced: December, 1908; final installation completed, June, 1913.
Highline pumping plant put in operation: June, 1913.
Highline Canal completed and operation commenced: June 16, 1913.
Raising of spillways, Roosevelt Dam, completed: August, 1913.
Joint Head Dam completed: March 1914.
Reconstruction of the Arizona Canal completed: February, 1915.
McQueen pumping plant completed: March, 1915.
Farm unit survey completed: April, 1915.
Water over spillways of Roosevelt Reservoir: April 14, 1915.
Survey for silt deposit in Roosevelt Reservoir: June, 1915.
South Side Canal system completed: June, 1915.
Installation of sixth unit, Roosevelt power plant. completed: November, 1915.
Cross Cut power plant completed: December, 1915.
Project 100 per cent completed: June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Salt River project provides for the storage of water in the reservoir created by the building of the Roosevelt Dam, which is situated at the confluence of Tonto Creek and Salt River, about 70 miles northeast of Phoenix, Ariz. This stored water is carried down Salt River to a point about 4 miles below the mouth of the Verde River, where, together with such water as may be discharged by the Verde, it is diverted to the North and South side canal systems by the Granite Reef Diversion Dam. The water supply for the canals on the north side of the river is further augmented by the water diverted by the Joint Head Diversion Dam.

There have been completed and put into operation nine pumping plants with an approximate capacity each of 10 second-feet. A pumping plant located at the junction of the Western Canal and the Kyrene branch pumps water through a 54-inch pressure pipe 5,930 feet long to an elevation of 40 feet and waters approximately 7,500 acres of land. The United States claims all waste, seepage, unappropriated spring, and percolating water arising within the project, and proposes to use such water in connection therewith.

The canal and lateral system at present comprises 806.25 miles, and on completion of the project provides for the delivery of water to each 160-acre tract of irrigable land.

A power plant located at Roosevelt generates power from stored water in the reservoir and from water delivered from the Power Canal, heading at a diversion dam in Salt River, 19 miles above the storage dam. Three other power plants have been constructed by the water users' association and have become a part of the project, viz, the South-Consolidated, the Arizona Falls, and the Cross Cut. A portion of the power developed will be used for pumping water for irrigation and the remainder for industrial purposes.

The principal features completed are the Intake Dam and Power Canal, the Roosevelt Dam, Granite Reef Dam, Joint Head Dam, the main canals of the distributing system and the greater part of the lateral system, and the power system, comprising four power plants, transformer house, transmission lines, switching station, and four substations. Some work remains to be done on the sluicing tunnel through the Roosevelt Dam, and rather extensive repairs are now needed on the Intake Dam and Granite Reef Dam.

SUMMARY OF GENERAL DATA FOR SALT RIVER PROJECT TO JUNE 30, 1916.

Areas:			
Irrigable acreage when project is complete			191,647.60
Public land entered, June 30, 1916		16,169.96	
State land, June 30, 1916		11,030.00	
Private land, June 30, 1916		164,447.64	
Acreage service could have supplied season of 1915			[1] 220,682.04
Estimated acreage service can supply July 1, 1917			191,647.60
Acreage actually irrigated, season of 1915			187,394
Acreage cropped under irrigation, season of 1915			171,832
Crops:			
Value of irrigated crops, season of 1915			$3,661,769.00
Value of irrigated crops, per acre cropped			$21.31
Finances:			
Estimated cost of completed project			$11,952,760.34
Total construction cost to June 30, 1916			$11,765,760.34
Per cent complete, June 30, 1916			100
Appropriation for fiscal year 1917, total			$618,500.00
Allotment for construction, fiscal year 1917			$187,000.00
Estimated per cent complete, June 30, 1917			100
Announced construction charges per acre			([2])
Appropriation, fiscal year 1916		$590,000.00	
Increase under 10 per cent provision of act		59,000.00	
Total appropriation			$649,000.00
Expenditures during fiscal year chargeable to 1916 appropriation—			
Disbursements	$396,986.86		
Transfers	30,913.30		
		$427,900.16	
Registered liabilities chargeable to 1916 appropriation		47,759.01	
			475,659.17
Unencumbered balance July 1, 1916			173,340.83
Repayments:			
Construction charges			([3])
Operation and maintenance charges (public notice)			([3])
Water rental charges—			
Accrued to June 30, 1916			1,638,665.58
Collected to June 30, 1916			1,629,907.36
Uncollected, June 30, 1916			8,758.22
Power earnings—			
Accrued to June 30, 1916			845,395.58
Collected to June 30, 1916			810,283.03
Uncollected, June 30, 1916			35,112.55
Drainage:			
Cost of drainage works to June 30, 1916, investigations			4,669.96

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[1] Includes 29,034.44 acres entitled to temporary water under orders of the Secretary of the Interior.

[2] Public notice not issued.

[3] Not applicable.

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

PRELIMINARY AND AUXILIARY WORK.

On account of the location of Roosevelt dam in a practically uninhabited region and at a great distance from railroads and large towns or cities, it was necessary to undertake considerable preliminary work before the construction of the dam could be commenced and to carry on auxiliary operations during its construction.

A camp was established at the site of the dam, office and shop buildings, power plants, and warehouses were built, residences for engineers and a hospital for the benefit of the laborers were constructed, and water, lighting, and sewer systems for the town of Roosevelt were established.

To facilitate the hauling of supplies to the work, many miles of wagon road were constructed by the Reclamation Service. In 1903 and 1904 roads were built from Roosevelt to the clay pits, to the sawmill, and for a part of the distance to Globe and to Mesa. The most important road and the one involving the heaviest work was that from Roosevelt to Mesa. The road traverses very rough country, and many deep cuts in solid rock were required in its construction. By the fall of 1904 about 80 miles of road had been constructed, and later additions have been made, bringing the total length built to 147 miles.

On December 26, 1903, a contract was executed for the construction of about 55 miles of telephone line from Arizona dam to Roosevelt, and from there to the diversion dam of the power canal. The line was completed in 1904 and the system was afterwards extended to Phoenix and other parts of the project.

In January, 1904, a sawmill was set up in the Sierra Ancha, 30 miles from Roosevelt, and in October, 1905, nearly 3,000,000 feet, board measure, of lumber had been manufactured for use on the project. Brick and lime kilns were established late in 1903, and during the winter of 1903–04 over 100,000 bricks and 2,000 barrels of lime were burned for use in the cement mill and other structures.

Cement mill.—Investigations and chemical analyses established the fact that a fine quality of Portland cement could be manufactured from clay and limestone found in ample quantities near the site of the dam. Consideration of the cost of freight and hauling necessary to secure cement from commercial manufacturers led to the conclusion that direct manufacture of the cement would save the Government much more than the total cost of constructing a modern cement mill. Excavation for the foundations of a two-kiln cement mill with a capacity of 350 barrels per day was begun by Government forces in November, 1903. The building was completed and all the machinery installed in March, 1905, and on April 21, 1905, the manufacture of cement was begun. The operation of the plant was discontinued in July, 1910, with a total output of 338,452 barrels. The average cost per barrel, including cost of plant, was $3.14, showing a saving of approximately $600,000 over the lowest price for delivery from outside sources.

POWER CANAL.

The power canal was built primarily for the purpose of furnishing power for the construction of the Roosevelt Dam. The canal has a capacity of 225 second-feet and heads at a diversion dam in Salt River 19 miles above Roosevelt.

The diversion dam for the power canal comprises a concrete ogee weir 400 feet long and 12 feet high and a low earth embankment about 300 feet long. There are a number of concrete-lined tunnels on the canal, aggregating 9,700 feet in length. Two wide and deep canyons at Cottonwood and Pinto Creeks are crossed by inverted siphons.

The final location survey of the power canal was completed in September, 1903, and proposals for the construction of the canal were opened December 8, 1903. In March, 1904, two contracts were executed, one for the tunnels and one for open canal excavations; the construction of the pressure pipes was authorized to be done by Government forces. The tunnels were completed in August, 1905, the open canal in November, 1905, and the pressure pipes in July, 1906. The inclined penstock tunnel at the end of the power canal was excavated by Government forces in 1905 and the work of lining it with steel and concrete was begun in September, 1905, and completed in February, 1906. The power canal was put in operation in the spring of 1906. In the summer of 1906 a temporary brush and rock diversion dam was utilized at the head of the power canal. The permanent dam was built by Goverment forces and completed on October 29, 1906.

OUTLET TUNNELS AND GATES.

Preliminary to construction work on the Roosevelt Dam a tunnel was driven on the south side through the rock walls of the canyon to serve as an outlet for the reservoir and to aid in removing the deposit of silt from the bottom. During the building of the dam the flow of the river was diverted through the tunnel.

Proposals for construction of the tunnel were opened December 22, 1903, and a contract was executed March 23, 1904. The tunnel was completed during 1904. Proposals for furnishing the gates for the sluicing tunnel were opened on October 1, and a contract was executed November 14, 1904. The delivery of the gates was completed in 1906, but on account of the tunnel being utilized to divert the river during the construction of the base of the dam, the gates were not installed until 1908, when the work was begun on January 31, and finished on July 2. On May 8, 1909, the gates were closed, and upon investigation it was found that the bottom of the tunnel and parts of the sides had become badly eroded. The floor was therefore lined with concrete and the part of the tunnel near the gates was lined with steel plates.

In January, 1915, work preliminary to the installation of navy bronze pipes and hydraulic valves in the sluicing tunnel was started. Beginning at a point 17 feet downstream from the sill of the sluice gates, there are two reinforced concrete passages, each 38 inches wide by 60 inches high, tapering from the top downward and extending 22 feet back to fit the four 5-foot sections of 38-inch round bronze pipes set in a heavy concrete plug, which is about 10 feet high by 14 feet wide at the beginning of the concrete passages and about 17 feet high by 22 feet wide at a point 37 feet below. At the lower end of the navy bronze pipes are bolted two vertical hydraulic 30 by 38 inch bronze valves. During February concreting was started, and work on excavation for the operating tunnel for the valves was also begun, and in March all the excavation up to the valves was completed; early in April all pipe was put in and all concrete up to the end of the plug poured.

Water came over the spillways on April 13, stopping all work, which was resumed in June, when more work was done on the operating tunnel and excavation made for the valve-operating chamber. High water stopped further work, but in August the tunnel was unwatered and cleaned out and two 30 by 38 inch valves set in place. All work has been completed to the lower faces of these hydraulic valves, which are 62.5 feet from the sill of the sluice gates. Completion of this work, according to approved plans, includes laying two 48-inch riveted pipes from this point to the mouth of the tunnel, a distance of about 300 feet, and connecting thereto two 38-inch needle valves now on hand, also making connection between these two pipes and the 7-foot power-canal penstock, so as to furnish lake water to power-canal generators.

ROOSEVELT DAM.

The Roosevelt Dam, located in the Salt River Canyon, just below the mouth of Tonto Creek, is a masonry arch gravity structure; the center line of the top has a radius of 410 feet. Its maximum height is 280 feet, its length on top 1,125 feet, and its width on top 16 feet.

General plans for construction of the dam were reviewed and approved on July 28, 1904, by a board of engineers consisting of Messrs. A .P. Davis, G. Y. Wisner, W. H. Sanders, and J. H. Quinton, and detail plans were designed and specifications prepared under the direction of the board. On February 8, 1905, proposals for construction were opened, and on April 21, 1905, a contract for the work was executed. On December 15, 1905, a board of engineers consisting of Messrs. A. P. Davis, W. H. Sanders, G. Y. Wisner, and Louis C. Hill recommended increasing the height of the dam 10 feet, raising the crest, exclusive of parapet, from 230 to 240 feet above stream bed. The recommendations were approved and the plans adopted.

In May, 1905, the contractor began to assemble equipment and to establish construction camps. In November, 1905, a cofferdam for diverting the river through the sluicing tunnel was constructed and excavation for the foundation of the dam begun. On September 20, 1906, the first masonry was laid in the dam, the work of excavating for the foundation having been delayed by repeated floods in the river. In the latter part of 1906, and during the seasons of 1907 and 1908, floods and high water in the river interfered to a considerable extent with the progress of the work. The last stone was laid in the dam on February 5, 1911, and formal dedication took place March 18, 1911.

Authority for raising the spillways from a height of 220 feet to 225 feet above datum was given June 10, 1913, and in July the work was commenced. Approximately 435 cubic yards of gravel were hauled for this work, 1,505 sacks of cement were used, and approximately 2,240 feet of three-fourths inch square twisted rods went into reinforcements; 325 cubic yards of concrete were added to the volume of the dam by the raising of the spillways.

The discharge of water over the spillways caused considerable damage and it was decided to concrete the floor of the spillways. This work was commenced in October, 1915, and completed in January, 1916, just four days before water again commenced going over the spillways. The total amount of concrete placed on both spillways is 1,595 cubic yards. Concrete was applied on both spillways to a minimum depth of 1 foot over bad rock, leaving good rock bare in places, and was formed in polygon-shaped blocks of varying heights to make an uneven surface, with the intention of checking water velocity as much as possible and reducing erosion.

POWER PLANTS AND TRANSMISSION LINES.

It was planned to utilize, in the operation of the cement mill and shops and in the construction of Roosevent Dam, electric power generated by water turbines supplied by the penstock at the end of the power canal. The machinery for generating current equivalent to 1,300 horsepower was installed in the fall of 1905 in a temporary power plant, located in a cave in the canyon at the end of the inclined penstock, and the operation of this plant was begun early in 1906 and continued until August, 1909, when power machinery in the permanent power plant was ready for use. The building for the permananet power plant is located on the south side of the river immediately below the dam, and is constructed of stone and concrete masonry. The building was erected by Government forces, excavation for the foundations being commenced in October, 1906, and the building completed in the spring of 1908. The penstock at the end of the power canal was extended into the power plant building and supplies water to an exciter unit and to three power units, each consisting of a vertical turbine direct connected with a three-phase, alternating-current generator. The first of these power units was installed and put in operation in June, and the second and third in August, 1909, after which the use of the power unit in the temporary power plant was discontinued. The installation of the fourth and fifth units, which are supplied with reservoir water through a 10-foot penstock, was completed in June, 1912. The sixth unit installation was completed in November, 1915. The first five units gave a plant capacity of 5,000 kilowatts and the sixth unit an added capacity of 5,000 kilowatts.

A short distance from the power house is a transformer house, in which are installed the transformers for stepping up the current, generated at 2,200 volts, to 45,000 volts for transmission. Other equipment necessary for control and distribution of the current generated in the power house is also installed in the transformer house.

Four power substations have been constructed—No. 1, 8 miles south of Mesa; No. 2, near Sacaton, on the Gila River Indian Reservation; one in Phoenix and one in Glendale. In these stations are installed the equipment necessary for controlling the distribution of the current and the transformers for stepping down the current to 10,000 volts, in substations Nos. 1 and 2 for distributing to pumping plants, and to 2,200 volts on distributing lines in Phoenix and Glendale. Power substation No. 1 was finished in July, and the installation of its equipment was completed in November, 1909. Power substation No. 2 was completed in October, 1909. The Phoenix substation was placed in service in December, 1910, and the Glendale substation on July 1, 1912.

The switching station was completed in 1909 and placed in operation with the remainder of the transmission line. It is located 1 mile east of the northeast corner of the town of Mesa. Its function is to divide the main transmission line into two sections and to provide means of cross connecting the two lines at this point in case of trouble. Provision is also made for connecting to either of the lines the branch circuit running north to the South-Consolidated and south to the Chandler and Sacaton substations. All of these are 45,000-volt circuits.

A main power transmission line extends from the power house at Roosevelt to Phoenix and is about 75 miles long. It consists of two circuits of three wires each and carries current at 45,000 volts. A branch line, 19 miles long and carrying one three-wire circuit, extends from the switching station to substation No. 2, and from this line about 8½ miles from the switching station a branch 1 mile in length extends to substation No. 1. Surveys for the transmission lines were made in the spring of 1907, and anchors for the towers were set in the summer of that year. Contracts for furnishing the towers and poles were executed in the spring of 1908 and the line was completed in 1909. In September of that year the delivery under contract of current for industrial purposes at Phoenix was commenced. In June, 1910, the use of the electric current for pumping water on the Gila River Indian Reservation was begun, two pumps having been installed and put in operation.

The main transmission line between Mesa and Roosevelt was reconstructed in 1913, being converted into a suspension type, long span line. The Inspiration Consolidated Copper Co. completed its line under contract of August 2, 1912, and service commenced March 21, 1914.

A single-circuit, 45,000-volt, wood-pole line connecting the Phoenix substation and the Glendale substation was placed in operation July 1, 1912. The South-Consolidated line is a 45,000-volt, single-circuit steel pole line connecting the South-Consolidated power plant with the switching station. Construction on the 11,000-volt distributing line was begun in 1909 and has been extended as required.

On August 30, 1910, a contract was entered into between the United States and the Salt River Valley Water Users' Association for the construction of three power plants in the valley, viz, the South-Consolidated, Arizona Falls, and Cross Cut, by means of funds furnished by the association. The South-Consolidated, of 2,000 kilowatts capacity, was placed in operation October, 1912, and the Arizona Falls, of 1,000 kilowatts capacity, in May, 1913; the Cross Cut, of 5,000 kilowatts capacity, was entirely completed in December, 1915.

GRANITE REEF DAM.

The Granite Reef Dam, located on Salt River about 4 miles below the mouth of Verde River, is a rubble concrete weir 1,000 feet long, with a maximum height of 38 feet, a base 36 feet wide, and curtain walls at heel and toe extending to bed rock near the ends of the dam and to a foundation of compact sand, gravel, and bowlders in the center of the channel, where a concrete apron 18 inches thick extends 75 feet downstream from the toe of the dam.

Borings at the site of the dam were made in June, 1906, and on July 26 of that year authority was granted by the Secretary of the Interior for the construction of the dam by Government forces. The work was begun in October, 1906, and completed in August, 1908.

JOINT HEAD DAM.

The Joint Head Dam, located in Salt River about 2 miles west of Tempe, was completed in March, 1914. This is a concrete weir 600 feet long, with a maximum height of 10 feet and containing 1,740 cubic yards of concrete. This dam diverts about 100 second-feet of water into the Joint Head Canal.

PUMPING PLANTS.

Wells have been drilled for the utilization of underground water for irrigation in a district from 6 to 8 miles south of Mesa and in the Gila River Indian Reservation. There are no flowing wells in the valley, water being found from 20 to 50 feet below the surface of the ground; the pumps for raising the water are operated by electric power generated by the power system of the United States Reclamation Service.

The drilling of wells on the Indian reservation was begun in April, 1908, and completed in March, 1909, nine wells being driven to an average depth of 233 feet. The wells are cased with double-steel stovepipe casings 16 inches in diameter.

The gravity supply of water for irrigation of the lands of Salt River project is augmented by the pumped water from nine batteries of wells—eight in the Mesa district, known as batteries A, B, C, D, E, and F, Clemans Well, and McQueen Well, and one, the San Francisco Well, located about 2½ miles west of the town of Tempe.

The drilling of the wells for batteries A, B, C, D, E, and F was commenced by the Reclamation Service in the latter part of 1908 and completed in the fall of 1909, but owing to shortage of funds the installation of the equipment was delayed and it was not until June, 1913, that the last installation was finally completed. Drilling operations were carried on by two Leidecker drilling rigs, operated by steam. Each of these pumping plants consists of a battery of three wells 16 inches in diameter, located in a straight line 30 feet apart, except battery A, where the wells are 25 feet apart. These batteries develop approximately 10 second-feet of water each, except battery A, which has developed but 8 second-feet.

The site of the San Francisco Well was included in the San Francisco Canal purchase, the agreement providing for the installation of a pumping plant at this point. Six wells were drilled, each 16 inches in diameter and spaced 50 to 75 feet between individual wells. Drilling was commenced in May, 1911, and completed in February, 1912. At this plant only 6 second-feet of water has been developed.

The Clemans Well was taken over by the Reclamation Service the latter part of the year 1910, and new installation later made. This plant consists of a battery of five wells, developing 11 second-feet of water.

Agreement was entered into on July 31, 1911, for the transfer of the McQueen Well to the United States, but the work of cleaning out and investigating this plant preparatory to reequipment was not begun until May, 1913. An entirely new installation of machinery was completed in March, 1915. This plant contains a battery of three wells, developing about 10 second-feet of water.

The depth of the wells varies from 205 to 303 feet, and the construction is uniform throughout on all the wells built by the Reclamation Service. Each plant is equipped with a centrifugal pump, driven by a 75-horsepower electric motor.

CANALS—ACQUISITION BY RECLAMATION SERVICE.

The canal systems of the Salt River project are divided by the Salt River into two distinct units, known as the north and south side systems.

North side.—All the canals of the north side system, with the exception of the Appropriators and those built later, were taken over by the Reclamation Service in 1906, but operation was not commenced until May 15, 1907. These canals were the Arizona, Arizona Cross Cut, Grand, Joint Head, Maricopa, and Salt River Valley. The operation of the Appropriators was commenced by the Reclamation Service in July, 1908, at the request of the company, but contract of purchase was not executed until January 19, 1909. The canals and the structures (mostly of wood) were in poor condition and constant improvements have been made; also, considerable new construction has been done.

The construction work on the north side system consisted of enlarging the Arizona and Grand Canals and the construction of new laterals and reconstruction of old laterals for all the canals. The Water Users' Association, under an agreement with the United States, completed the enlargement of the Grand Canal, and constructed the Grand Canal extension from the side of the Cross Cut power plant to the head of the Grand Canal, and also the New Arizona Cross Cut Canal from the Arizona Canal to the Cross Cut power plant. In the early part of 1916, floods from the Salt River washed out a portion of the Grand Canal extension between the Cross Cut power plant and the Joint Head Dam, and it was necessary to relocate 1 mile of this canal. This was done by Government forces and was completed the latter part of April, 1916.

South side.—On the south side system the canals are the South, Eastern, Main Consolidated, East Branch Consolidated, Mesa, San Francisco, Western, and Highline. The main feeder canal from Granite Reef, the South Canal, was constructed by the Reclamation Service and was completed in May, 1909, and operation commenced in June of that year. The Eastern Canal was constructed under the cooperative plan and completed in December, 1909. The Main Consolidated and East Branch Consolidated Canals were acquired by purchase in July, 1909, and operation was begun by the Reclamation Service in the fall of 1909. In the spring of 1910 the operation of the Mesa Canal system and the Eureka Canal, a part of the Utah Canal system, was begun by the Reclamation Service under agreements to purchase the canals at appraised valuations and pay for them by allowing to the stockholders credits on building charges to be thereafter assessed by the Secretary of the Interior. The San

Francisco Canal was acquired by purchase, and operation commenced January 1, 1913.

The Western Canal was built partly by Government forces and partly by the Western Canal Construction Co. and deeded by that company to the United States. The Highline Canal, a 40-foot lift canal, was constructed by the Highline Canal Construction Co., and by them turned over to the Reclamation Service. Delivery to the Western was commenced on February 16, 1913, and to the Highline on June 16, 1913.

DESCRIPTION OF CANAL SYSTEM.

North side.—The main feeder on the north side of Salt River is the Arizona Canal, which commences at the north intake structure of the Granite Reef Dam and runs westerly and northwesterly for a distance of 42 miles to Skunk Creek, just above its confluence with New River. The New Cross Cut leaves the Arizona Canal at a point near the northeast corner of section 28–2N–4E, and runs south for 3½ miles to the Cross Cut power plant. The Grand connects with the New Cross Cut at the Cross Cut power plant, and from thence runs in a northwesterly direction to New River. The Grand is connected with the Joint Head Canal through a short canal known as the Grand Cross Cut in section 7–1N–4E, one-half mile long, so that water can be delivered from the Arizona to the Grand and thence to the Salt River Valley and Maricopa Canals through the Joint Head Canal. In this way water intended for either the Maricopa or Salt River Valley Canals can be run through the Arizona, then through the New Cross Cut into the Grand, and used to generate power in the Cross Cut power plant. The Maricopa and Salt River Valley Canals have a common head in the Joint Head Canal, which runs from the Joint Head Dam to the divergence of these canals in section 12–1N–3E. The Joint Head Canal is 1½ miles in length. From the divergence of the two canals the Maricopa runs northwesterly for a distance of 11½ miles, and the Salt River Valley runs westerly for a distance of 16½ miles. From all of these canals are numerous laterals supplying water to lands lying under the respective canals, the entire length of the canals and laterals of the north side system totaling 465.5 miles.

South side.—The main feeder of the south side system is the South Canal, commencing at the south intake structure of the Granite Reef Dam and running in a southwesterly direction for 2 miles, where it divides into the Main Consolidated and Eastern Canals. The Eastern Canal is the highline canal of the east part of the system and runs in a southerly direction to the township line between townships 1 and 2 south. This canal is 19½ miles in length. The Main Consolidated Canal runs southwesterly from the South Canal to the division gates in section 11–1N–5E, a distance of 7¾ miles. At the division gates the water is divided into three canals, the East Branch of the Consolidated running easterly then south, a distance of 18½ miles, the Mesa Canal extending southwesterly and westerly for 3¼ miles and dividing into numerous laterals in the vicinity of the town of Mesa, and the Tempe Cross Cut, 2¼ miles long, running west from the division gates. The Western Canal is supplied with water by feeders from the East Branch Consolidated Canal. This canal heads on the east section line of section 8–1S–5E (the end of the Wallace feeder), extending westward 2½ miles, then dividing into the main canal and the Kyrene branch, the main canal running northwesterly then southwesterly, the Kyrene branch extending southwesterly. The Western Canal, exclusive of the feeders, has a length of 25½ miles. At the point of diversion of the Kyrene branch of the Western is a pumping plant which lifts the water 40 feet from the Western Canal to the Highline, through a reinforced concrete pressure pipe approximately 6,000 feet in length. The Highline Canal runs from the outlet of the pressure pipe both ways around the base of the Salt River Range, and is 15¾ miles in length. The San Francisco Canal secures its water through the Tempe Canal at a point in section 15–1N–4E, near the town of Tempe, and runs westerly a distance of 3¼ miles, then divides into the North and South branches, extending westerly and southwesterly, respectively. The length of the South Side Canal and lateral system is 340¾ miles.

The following is a tabulation of data pertaining to the canal systems of Salt River project:

Statement showing data pertaining to canal systems, Salt River project.

Canal.	Date of—		Operation commenced by United States Reclamation Service.	Mileage Nov. 30, 1915.			Capacity main canal, second-feet.	Original construction commenced.
	Contract.	Completion of purchase.		Main canals.	Laterals.	Total.		
Arizona	Feb. 17, 1906	June 20, 1906	May 15, 1907	38.25	204.75	243.00	2,000	1883
Arizona Cross Cut	do	June 15, 1906	do	3.50	....	3.50	600	1889
New Cross Cut	(1)	(1)	1913	3.50	....	3.50	700	1912
Grand	Feb. 17, 1906	June 15, 1906	(2)	27.50	84.00	111.50	350	1878
Grand Cross Cut	....	....	....	.50	....	.50	....	....
Appropriators	Jan. 19, 1909	Jan. 19, 1909	July 4, 1908	(3)	(3)	(3)	....	....
Joint Head	Feb. 17, 1906	June 15, 1906	May 15, 1907	1.50	....	1.50	300	1867
Maricopa	do	do	do	11.50	20.75	32.25	150	1868
Salt River Valley	do	do	do	16.25	53.50	69.75	250	1867
South [4]	(4)	(4)	June 4, 1909	2.00	....	2.00	1,600	1908
Eastern [5]	(5)	(5)	Mar., 1910	19.50	55.25	74.75	200	1909
Main Consolidated	Nov. 19, 1908	July 10, 1909	Nov. 17, 1909	7.75	.50	8.25	1,250	1892
East Branch Consolidated	do	do	do	18.50	83.25	101.75	450	1892
Tempe Cross Cut	do	do	do	2.25	....	2.25	270	....
Eureka	Aug. 1, 1910	Apr. 20, 1916	June 15, 1910	(6)	(6)	(6)	....	....
Mesa	May 7, 1910	Nov. 26, 1915	do	3.25	42.50	45.75	125	1879
San Francisco	Mar. 6, 1911	Dec. 31, 1912	Jan. 1, 1913	3.25	20.50	23.75	70	1871
Western (constructed by United States Reclamation Service) [7]	....	....	....	(8)	(8)	(8)	175	1911
Western (constructed by Western Canal Construction Co.) [9]	....	....	Feb. 16, 1913	25.50	25.00	50.50	....	1912
Highline (constructed by Highline Canal Construction Co.) [10]	....	....	June 16, 1913	15.75	16.00	31.75	....	1912

[1] Built by W. U. Association.
[2] When combined with Appropriators.
[3] Not in use—combined with Grand.
[4] Constructed by United States Reclamation Service; completed June, 1909.
[5] Cooperative and United States Reclamation Service work.
[6] Mileage included in Mesa System.
[7] Constructed in 1911 and 1912.
[8] Included below.
[9] Construction completed in 1913.
[10] Construction completed in 1913.

CONSTRUCTION DURING FISCAL YEAR.

Roosevelt Dam.—On October 16, 1915, work was commenced on concreting the floor of the spillways of the Roosevelt Dam, and was continued until January 17, when it was stopped on account of the impending overflow from the reservoir. The concrete was applied to a minimum depth of one foot over bad rock, leaving good rock bare in places, and was formed in polygon shaped blocks of varying heights to make an uneven surface, with the intention of checking water velocity as much as possible and reducing erosion. A total of 1,595 cubic yards of concrete was placed.

Sluicing tunnel, Roosevelt Dam.—The installation of the navy-bronze pipes in the sluicing tunnel, which had been commenced in January, 1915, and discontinued on account of overflow from the reservoir, was resumed in July. The pipes and valves are now in place and the operating tunnels driven; the completion of the work depends on plans under consideration.

Sixth unit, Roosevelt power plant.—The installation of the sixth and final unit of the Roosevelt power plant was completed during the fiscal year and placed on the line November 24, 1915. This unit is of 5,000 K. W. capacity, generating as much power as the other five units of the plant; the operation is very satisfactory.

Water Users' Association work.—The Cross Cut power plant was finally completed in December, 1915, and the efficiency test made January, 15–16, 1916, after a satisfactory 30-day run.

BOARDS OF ENGINEERS.

On September 28, 1915, a board of engineers, composed of Messrs. D. C. Henny, E. H. Baldwin, and William S. Cone, met to consider various matters in connection with the power canal, sluicing and outlet tunnels, silt deposits, etc., above Granite Reef and Roosevelt Dams. The reports made by this board were dated October 1, 1915.

March 6, 1916, a board consisting of Messrs. D. C. Henny, Louis C. Hill, and William S. Cone, met to report on damages and to recommend procedure in connection with Roosevelt power plant and spillways, Intake Diversion Dam, and the Main Consolidated and Grand Canals. The reports covering findings and recommendations were made under date of March 10, 1916.

May 7 Mr. D. C. Henny arrived to inspect and report on damage to apron of Granite Reef Dam and retaining wall of Arizona Canal, just below the dam.

On June 20 a board of engineers convened on the project, consisting of Messrs. D. C. Henny, E. H. Baldwin, Louis C. Hill, O. H. Ensign, and William S. Cone, to report on conditions at Roosevelt and make recommendations for clearing the river channel below the spillways of the dam, and for the North Outlet Tunnel control. The reports on these features were dated June 23, 1916.

OPERATION OF POWER SYSTEM.

The capacity of the Roosevelt power plant was doubled during the fiscal year by the addition of the sixth unit of 5,000-kilowatt capacity, which was placed in operation on November 24, 1915. The plant was operated continuously during the year, with the exception of from

January 18 to February 22, when the power house was flooded by high backwater from the spillways, and from February 29 to March 2, 1916, this shutdown being caused when a large portion of the cliff above became undermined and great masses of rock fell into the river, tearing down the power and control cables between the transformer house and the power house. Operation during all of 1916 up to May 30 was somewhat handicapped by the spillway overflow, the moisture causing some insulator and pot-head breakdowns, also necessitating an extra crew of men at the transformer house, as passage between the two buildings was impossible. The control cable for the transformer house switches has not yet been received, thus handicapping switching changes at the transformer house, control from the power-house switchboard being cut off. The flood of January carried away the intake dam, thus rendering the power canal useless, and the three generators in the power house receiving water from this canal have been idle since June 15 (up to which time they received water from the lake through the forebay gates) and will remain so until the authorized connection between the power canal penstock and the sluicing tunnel is installed, when these machines will receive water from the reservoir and it will again be possible to operate the plant to capacity.

At the close of the fiscal year there is being delivered to the Inspiration Consolidated Copper Co., the largest consumer of power generated in the plants of this project, an average of 128,896 kilowatt hours daily, bringing in a revenue of $29,001.75 for the month of June.

The South-Consolidated and Arizona Falls plants were operated as continuously as the flow of water in the canals would allow.

The Cross Cut power plant was entirely completed December 15, and after a satisfactory 30-day run an efficiency test was conducted on January 15 and 16. The machine selected for the test showed an average efficiency of 79 per cent, or 4 per cent more than the manufacturer's guarantee, and the plant was accepted by the Reclamation Service and turned over by the water users' association. Previous to the end of November the Pelton-Doble Co. were making changes in the hydraulic equipment, thus leaving only half the plant available for operation, but one or two units were in operation practically all of the period up to December 15, and since that date all of the plant has been operated as continuously as the flow of water in the Cross Cut Canal would permit, with the exception of the periods between January 19 and February 8, and February 24 to 28, inclusive, when operation was irregular, being seriously interrupted by water conditions below the plant, where the Salt River had washed out a large section of the Grand Canal. The plant was entirely shut down from March 3 to May 7, inclusive, while the work on the relocation of the Grand Canal was being carried on, but since the latter date it has been running continuously.

OPERATION AND MAINTENANCE.

Irrigation works operated during the fiscal year 1916 included the Roosevelt Reservoir, Granite Reef Dam, Joint Head Dam, the Arizona, Grand, Maricopa, and Salt River Valley Canals on the north side of Salt River, and the South, Eastern, Main Consolidated, East Branch Consolidated, Mesa, San Francisco, Western, and Highline Canals on the south side. In addition, water was pumped. from batteries A, B, C, D, E, F, Clemans, McQueen, and San Francisco wells in connection with the water distribution on the south side.

Water was supplied to the north side canals after diversion from Salt River, through the Arizona and the Joint Head Canals, and on the south side through the South Canal. The total area irrigated with water supplied through the canals of the United States Reclamation Service was 189,082 acres. About 12,000 acres lying under the Tempe Canal were supplied with water diverted by the Reclamation Service at Granite Reef and carried through the South and Main Consolidated Canals to the division gates, then through the Tempe Cross Cut into the Tempe Canal. The Tempe Irrigating Canal Co. is an independent organization, and the water was supplied to the head of their canal in accordance with contract approved May 15, 1915. On December 23, 1915, contract was entered into with the Utah Irrigating Ditch Co. for the delivery through the canals of the United States Reclamation Service of the amount of water decreed to the water users under the Utah Canal. The amount to be delivered is limited to a maximum of 40 second-feet.

For the year ending June 30, 1916, there were diverted through the canals of the Reclamation Service, for irrigation of lands under Salt River project, 1,141,149 acre-feet of water, of which 798,804 acre-feet (estimated) were actually applied to the land.

On January 29, 1916, the Roosevelt Reservoir reached its maximum contents for the season, at an elevation of 236.4 feet, which represented a volume of 1,563,720 acre-feet of water within the reservoir. From January 18 to May 30, 1916, a period of 134 days, water poured over the spillways representing a total of 2,133,854 acre-feet, only part of which could be utilized for irrigation and for generating power. The minimum amount stored in the Roosevelt Reservoir during the fiscal year was on December 30, 1915, when the gage height was 202.46 feet and the contents 1,014,107 acre-feet. On June 30, 1916, the elevation of the reservoir was 219.48 feet, representing a storage of 1,275,586 acre-feet, a net loss at the end of the fiscal year of 3.88 feet in elevation and a volume of 64,162 acre-feet.

Operation and maintenance work, as in previous years, consisted almost entirely of removing sediment from canals and laterals, cleaning weed growth along the banks, removing moss from the beds of the main canals, and repairing existing structures, as well as installing a few checks, turnouts, and bridges. Weed growth was removed from banks of canals and laterals with the use of shovels, scythes, mowing machines, and by grazing of sheep and goat herds. One herd of goats, 536 head, and two bands of sheep, 1,237 head, maximum number, were pastured on the banks of canals and laterals during the weed-growing season and on the desert during the winter months. Satisfactory profits were obtained from the sheep and goat venture and it is expected to increase the herds.

Water was turned out of some of the canals during the months of January and February to allow maintenance crews to remove silt deposits and berms. During the other months of the season water was in all the canals except in the Main Consolidated and the canals supplied with water from this canal. Due to the high stage of the river and because of a shifting of the river bed, the Salt River broke through into the Main Consolidated Canal during the month of January, 1916, and made necessary extensive repairs. During the same flood period the Grand Canal just below the Cross Cut power plant was damaged to such an extent that it was necessary to relocate this canal for 1 mile. This work was begun January 30, 1916, and ended May 10.

At the end of the fiscal year 1915 the Reclamation Service owned and operated 782.6 miles of canals and laterals, and at the end of the fiscal year 1916 this had been increased to 806.25 miles.

The pumping plants were operated whenever occasion demanded. No trouble was experienced during the year in the operation of any of the pumps.

During the early winter of 1915 heavy snow fell in the higher elevations of the Salt and Verde River watersheds. Later in the year and in the month of January heavy rain melted the snow and caused a run-off heavier than for many years past. On January 18 the reservoir made a record gain of 157,981 acre-feet, which brought the surface of the water to the crest of the spillways. The day following there was a further increase of 182,110 acre-feet which caused an overflow of 7.15 feet over the spillways. For a period of 165 days, owing to the high stage of the river, irrigation water was delivered to the water users of the project at half price; that is, each acre-foot of water delivered was charged at the price of one-half acre-foot. The contract rates for the season 1915–16 are as follows: A minimum charge of $1 for not to exceed 2 acre-feet per acre, 50 cents for the third and 50 cents for the fourth acre-foot, and 75 cents per acre-foot for all in excess of 4 acre-feet per acre for land signed and in good standing in the water users' association; and for land not signed in the water users' association, or delinquent in that association, $1.20 as a minimum for not to exceed 2 acre-feet per acre, 60 cents for the third and 60 cents for the fourth acre-foot, and 75 cents for all in excess of 4 acre-feet per acre.

On October 12, 1915, the time limit for the delivery of irrigation water to the "uncultivated area," as defined by the board of survey, was extended from October 1, 1915, to December 1, 1916. The rates are 60 cents for the first acre-foot and 60 cents per acre-foot for all in excess of 1 acre-foot per acre.

On account of the plentiful supply of water, due to flood conditions, the delivery of water for a long period of time at one-half the contract rates caused the water users to irrigate heavily during the flood period, and consequently the duty of water for the agricultural year 1915–16 will probably be lower than for the preceding year.

In the following table, "Historical review, Salt River project," it will be noted that the water duty was much lower for the year 1916 than for the years 1913, 1914, and 1915. This is due partly to the fact that the water supply was more plentiful in 1916, and partly to the fact that investigations made during this last year have shown that the water delivered is approximately 68 per cent of the water diverted (which figure is used for 1916) instead of 60 per cent, the figure used for the past two or three years.

Historical review, Salt River project.

	1911	1912	1913	1914	1915	1916
Acreage for which service was prepared to supply water	160,000	160,000	190,000	187,112	192,000	[1]191,647.6
Acreage irrigated	115,042	128,628	163,312	187,112	192,000	189,082
Miles of canal operated	534	576	715	715	782.6	806.25
Water diverted (acre-feet)	551,093	663,266	770,063	804,924	831,438	996,600
Water delivered to land (acre-feet)	352,699	430,928	462,037	446,730	498,862	677,688
Per acre of land irrigated (acre-feet)	3.53	3.94	2.97	2.62	2.66	[2]3.58

[1] 191,647.6 acres is the amount recommended by the board of survey report dated May 25, 1916, to be included in first unit of Salt River project.

[2] See paragraph immediately preceding "Historical review," for explanation of lower duty of water than for preceding years.

SETTLEMENT.

Few new settlers arrived on the project and little farm property changed hands by sale, though many exchanges were made. Higher prices received at the close of the irrigation season of 1914–15 caused considerable improvement in the situation, and in the first six months of 1916 all conditions were favorable for an exceedingly good season for the water users. A cow-testing association was formed and additional associations for this purpose are being organized. A county farm-improvement association was formed, consisting of a councilman from nearly all the local organizations in the county. There was no appreciable change in population during the year.

Settlement data, Salt River project.

Item.	1912	1913	1914	1915	1916[1]
Total number of farms on project	2,954	2,680	3,068	3,600	3,004
Population	18,250	20,000	20,500	22,000	22,000
Number of irrigated farms	2,954	2,680	3,068	3,600	3,004
Operated by owners or managers	1,999	1,945	2,459	2,700	2,333
Operated by tenants	955	735	609	900	671
Population	18,250	20,000	20,500	22,000	22,000
Number of towns	11	11	11	12	12
Population	25,000	26,600	30,500	31,000	31,000
Total population in towns and on farms	43,250	46,600	51,000	53,000	53,000
Number of public schools	50	52	60	60	60
Number of churches	44	48	50	50	50
Number of banks	9	11	11	12	10
Total capital stock	$681,000	$925,100	$798,500	$828,500	$1,333,500
Total amount of deposits	$6,716,292	$7,986,234	$8,353,519	$9,000,000	$7,189,265

[1] Estimated; exact figures not available.

PRINCIPAL CROPS.

The area in cotton for the agricultural year ending September 30, 1915, was much smaller than the year previous. The area in long-staple cotton was 1,830 acres, valued at $128,100. This reduced acreage was due to the losses experienced in the previous year by the growers on account of poor market prices. The returns from the lettuce shipments were more satisfactory this year than any year previous, due to proper methods of marketing and preparing for shipment. The alfalfa market was good, and at the end of the fiscal year all previous records for shipment of alfalfa were broken. Citrus fruits are in excellent condition. A large wheat crop was harvested, but the production of barley was below normal on account of smaller acreage. Olives are unusually large and the crop promises to be a record breaker both for quantity and quality. The ideal spring weather was favorable for all kinds of crops.

From indications at the close of the fiscal year the agricultural year of 1915–16 should be a big money maker for the water users of the project.

Crop report, Salt River project, Arizona, year ending Sept. 30, 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	78,337	Ton	235,011	3	$5.00	$1,175,055	$15.00
Alfalfa seed	4,669	Bushel	23,345	5	6.60	154,077	33.00
Barley	16,459	...do	329,180	20	.65	213,967	13.00
Beans	1,111	...do	17,776	16	2.40	42,662	38.40
Cane, sugar	697	Ton	5,576	8	4.00	22,304	32.00
Corn, broom	110	...do	55	.5	75.00	4,125	37.50
Cotton:							
Long	1,830	Pound	640,500	350	.20	128,100	70.00
Short	330	...do	132,000	400	.08	10,560	32.00
Cantaloupe	1,604	...do	6,255,600	3,900	.02	125,112	78.00
Corn:							
Indian	1,193	Bushel	29,825	25	1.10	32,807	27.50
Sorghum	26,260	Ton	26,260	1	20.00	525,200	20.00
Fodder	72	...do	216	3	6.00	1,296	18.00
Citrus fruits	1,054	Pound	1,874,012	1,778	.04	74,960	71.12
Fruits:							
Small	584	...do	1,168,000	2,000	.06	70,080	120.00
Deciduous	1,944	...do	7,776,000	4,000	.02	155,520	80.00
Garden	1,489					134,010	90.00
Hay, oats	1,074	Ton	2,148	2	10.00	21,480	20.00
Oats	2,300	Bushel	80,500	35	.75	60,375	26.25
Olives	135	Pound	135,000	1,000	.04	5,400	40.00
Pasture	36,119					433,428	12.00
Potatoes	267	Bushel	10,680	40	1.00	10,680	40.00
Potatoes, sweet	59	...do	3,540	60	.60	2,124	36.00
Wheat	11,230	...do	202,140	18	1.05	212,247	18.90
Watermelons	462	Ton	5,082	11	9.09	46,200	100.00
Less duplicated areas	17,557						
Total cropped acreage	171,832	Total and average				3,661,769	21.31
Irrigated, no crop:							
Young citrus	500						
Young olives	310						
Young deciduous	700						
Miscellaneous	1,769						
Total irrigated farm acreage	175,111						
Total area town sites	4,239						
Total irrigated acrege	179,350						
Water bought land vacant	8,044						
Total area under contract	187,394						

Areas.	Acres.	Farms.	Per cent of project.[1]
Total irrigable area farms reported	194,866	3,004	92
Total area town sites, special contracts	4,239		2
Under rental contracts	[2] 175,111	3,004	87
Total cropped area farms reported	171,832	3,004	81

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[1] Based on 211,866 acres.

[2] In addition water was bought for 8,044 acres not irrigated.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 696.]

Feature costs of Salt River project, June 30, 1916.

Principal feature.	Cost to June 30, 1916.	
	Subfeature.	Principal feature.
Examination and surveys		$83,939.83
Storage works, Roosevelt Reservoir:		
Roosevelt Dam	$3,190,005.21	
Spillways	44,566.13	
Sluicing tunnel	74,794.93	
Hydraulic gates	249,841.27	
Repairs to tunnel and gates	95,242.05	
Overflow weir	8,966.55	
Right of way	168,341.94	
Outlet tunnel	58,429.18	
Roads	3,385.13	
		3,893,572.39
Pumping for irrigation:		
Battery A	16,425.49	
Battery B	20,603.87	
Battery C	16,734.94	
Battery D	19,358.12	
Battery E	21,848.29	
Battery F	16,808.09	
Cleman's wells	8,124.41	
San Francisco	29,978.98	
McQueen	17,245.44	
Test wells	178.75	
		167,806.38
Canal system:		
Granite reef dam	627,057.66	
Joint head dam	39,528.93	
Canal system	1,713,948.51	
		2,380,535.10
Lateral system		619,439.42
Drainage system, investigation		4,669.96
Power system:		
Diversion dam	127,353.22	
Power canal	1,474,063.01	
Roosevelt power plant	557,559.86	
South consolidated	163,139.60	
Cross cut	480,454.68	
Arizona Falls	109,500.73	
Plant No. 5 (engineering)	66.00	
Transmission lines	748,034.64	
Switching and substations	94,581.75	
		3,754,753.49
Farm units		28,123.47
Permanent improvements and lands:		
Lands not submerged by reservoir	37,642.90	
Roads	620,942.20	
Buildings and grounds	105,101.07	
		763,686.17
Telephone system		69,734.13
Operation and maintenance during construction (rental basis)		2,468,906.29
Plant accounts		44,910.72
Gross cost of construction of project to June 30, 1916		14,279,577.35
Less revenues earned during construction period:		
Rental of buildings	15,783.88	
Rental of grazing and farming lands	19,107.14	
Rentals, power and light	845,395.58	
Rentals of irrigation water	1,638,665.58	
Contractors' freight refunds	19,269.63	
Forfeitures by defaulting bidders and contractors	7,816.30	
Other revenues, unclassified	56,941.58	
Profit on mess-house operations	18,254.76	
Profit on mercantile store operations	2,609.37	
Loss on hospital operations	[1] 276.11	
		2,623,567.71
Amounts set up as reserves or depreciation charged to cost and not expended		320,484.56
		2,944,052.27
Net cost of construction of project to June 30, 1916		11,335,525.08

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[1] Deduct.

Estimated cost of contemplated work, Salt River project, during fiscal year 1917.

Feature.	Sub-feature.	Principal feature.
Storage works:		
Spillways	$50,500.00	
North outlet tunnel	60,000.00	
		$110,500.00
Drainage system, investigations		5,000.00
Power system:		
Connection with pen stock	40,000.00	
Excavation river channel	27,500.00	
Protection transformer station	750.00	
Road to power house	1,250.00	
		69,500.00
Farm units		2,000.00
Operation and maintenance during construction (water rental basis)		[1] 426,500.00
Messes		4,000.00
Hospitals		1,000.00
Total		618,500.00

[1] Includes plant account, $9,500.

ARIZONA-CALIFORNIA, YUMA PROJECT.

L. M. LAWSON, project manager, Yuma, Ariz.

LOCATION.

Counties: Yuma, Ariz.; Imperial, Cal.

Townships: 3 to 13 S., Rs. 21 to 25 W., Gila and Salt River meridian; 9 to 17 S., Rs. 16 to 23 E., San Bernardino meridian.

Railroads: Southern Pacific; Yuma Valley Railroad.

Railroad stations and estimated population January 1, 1916: Yuma, Ariz., 4,500; Potholes, Cal., 25.

WATER SUPPLY.

Source of water supply: Colorado River.

Area of drainage basin: 229,000 square miles above Laguna Dam.

Annual run-off in acre-feet of Colorado River at Yuma (287,000 square miles), 1902 to 1915: Maximum, 26,000,000; minimum, 7,960,189; mean, 16,498,000.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916: 72,440 acres.

Area under water-right applications and rental contracts, season of 1916: 72,440 acres.

Length of irrigating season: 365 days.

Elevation of irrigable area: 100 to 300 feet above sea level.

Rainfall on irrigable area: Five-year average, 2.99 inches; 1915, 4.33 inches.

Range of temperature on irrigable area: 22° to 118° F.

Character of soil of irrigable area: Bottom lands, rich alluvium; mesa lands, fresno gravelly sand.

Principal products: Semitropical fruits, alfalfa, grain, and cotton.

Principal markets: Los Angeles and San Francisco, Cal.; Arizona towns; and eastern markets for early produce.

LANDS OPENED FOR IRRIGATION.

Dates of public notices: January 12, 1910; March 8, 1912; March 6, 1913; June 23, 1913; April 7, 1916.

Location of lands opened: Ts. 15 and 16 S., R. 23 E., San Bernardino meridian.

Present status of irrigable lands opened: 6,500 acres entered, subject to the reclamation act and the act of April 21, 1904.

Limit of area of farm units: Public, 40 acres.

Duty of water: 3½ acre-feet per acre per annum at the farm.

Building charge per acre of irrigable land: $55 and $66.

Annual operation and maintenance charge: $1.50 per acre minimum charge, which entitles the water user to 2 acre-feet per acre of irrigable land. Water in excess of this amount will be charged at 75 cents per acre-foot.

CHRONOLOGICAL SUMMARY.

Reconnoisance made and preliminary surveys begun in 1902.

Construction recommended by board of engineers April 8, 1904.

Construction authorized by Secretary May 10, 1904.

Canal system of Colorado Valley Pumping & Irrigating Co. purchased March 15, 1907.

First irrigation by Reclamation Service, season of 1907.

Canal system of Yuma Valley Union Land & Water Co. (Farmers' Gravity Canal) purchased February 3, 1908.

Rollins ditch (including Ives heading pumps and ditches) purchased July 28, 1908.

Laguna Dam completed March, 1909.

Colorado River siphon completed June 29, 1912.

Gravity water from Laguna Dam furnished to Yuma Valley through siphon June 29, 1912.

Yuma Valley Railroad constructed June, 1914.

Entire project 59.8 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Yuma project provides for the diversion of water from the Colorado River at the Laguna Dam, 10 miles northeast of Yuma, Ariz., into two canal systems, one heading on the California side, conveying water to the irrigable lands on that side of the river, including those in the Yuma Indian Reservation, crossing the river at Yuma through an inverted siphon and serving lands in the Colorado Valley below Yuma, and the other heading on the Arizona side of the stream and watering lands in the Colorado and Gila Valleys lying east of the Colorado and north of the Gila. The plan also provides for a large pumping plant about 2½ miles below Yuma on the east main canal for raising water to irrigate 40,000 acres of mesa land. The lands adjacent to the Colorado River are protected from overflow by means of levees. The United States claims all waste, seepage, unappropriated spring, and percolating water arising within the project, and proposes to use such water in connection therewith. The Laguna Dam, 332 miles of canals and laterals, including 16 miles of drainage ditches; the Colorado River siphon, 930 feet in length and 14 feet in diameter; and about 74 per cent of the levee system are completed.

SUMMARY OF GENERAL DATA FOR YUMA PROJECT TO JUNE 30, 1916.

Areas:		
Irrigable acreage when project is complete		128,000
Public land entered, June 30, 1916	6,500	
Public land withdrawn, June 30, 1916	44,000	
State land, June 30, 1916	7,100	
Indian land, June 30, 1916	8,500	
Private land, June 30, 1916	61,900	
Acreage service could have supplied season of 1915		71,200
Addition in fiscal year 1916		1,240
Estimated addition in fiscal year 1917		500
Estimated acreage service can supply July 1, 1917		72,940
Acreage actually irrigated, season of 1915		27,857
Acreage cropped under irrigation, season of 1915		25,101
Crops:		
Value of irrigated crops, season of 1915		$873,721
Value of irrigated crops per acre cropped		$34.81
Finances:		
Estimated cost of completed project		$13,180,609.97
Total construction cost to June 30, 1916		$7,880,563.09
Per cent complete June 30, 1916		59.8
Appropriation for fiscal year 1917, total		$759,000.00
Allotment for construction, fiscal year 1917		$384,500.00
Estimated per cent complete June 30, 1917		63.90
Announced construction charges per acre for lands in California		$55–$66
Appropriation, fiscal year 1916	$825,000.00	
Decrease under 10 per cent provision of act	3,500.00	
Total appropriation		$821,500.00

Finances—Continued.			
Expenditures during fiscal year chargeable to 1916 appropriation—			
Disbursements	$453,071.66		
Transfers	30,225.03		
		$483,296.69	
Registered liabilities chargeable to 1916 appropriation		63,021.64	
			$546,318.33
Unencumbered balance, July 1, 1916			$275,181.67
Repayments:			
Construction charges—			
Accrued to June 30, 1916			$401,607.42
Collected to June 30, 1916			$269,999.24
Uncollected June 30, 1916			$131,608.18
Operation and maintenance charges (public notice)—			
Accrued to June 30, 1916			$70,657.54
Collected to June 30, 1916			$60,879.77
Uncollected June 30, 1916			$9,777.77
Water rental charges—			
Accrued to June 30, 1916			$279,440.50
Collected to June 30, 1916			$273,971.44
Uncollected June 30, 1916			$5,469.06
Drainage:			
Estimated acreage damaged by seepage to June 30, 1916			2,600
Miles of drains built to June 30, 1916—			
Open		11.5	
Closed		4	
Total			15.5
Estimated acreage protected by drains built to June 30, 1916			5,000
Estimated acreage to be protected by authorized system			17,500
Expended to June 30, 1916, for drainage works completed and uncompleted			$153,031.76

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

LAGUNA DAM.

Laguna dam is located on Colorado River about 10 miles above Yuma, where granitic mountains encroach on the river valley, leaving an opening about a mile wide. Rock foundations for a dam could not be secured, and the Indian type of diversion dam was selected as being most suitable for the conditions.

On March 15, 1905, proposals for the construction of the dam were opened, but extensive floods caused a delay in receipt of proposals and all were rejected. The work was readvertised, and proposals were opened on June 5, and contract awarded on July 6, 1905. The work of construction was commenced by the contractors on July 19, 1905. In August, 1906, the contractors petitioned for relief from the contract for various reasons. The release was granted on January 23, 1907, about 34 per cent of the work provided for in the contract having been done by the contractors. The work was taken up by the Reclamation Service and was completed on March 20, 1909.

Proposals for furnishing and installing sluice gates, regulator gates, and operating machinery for the main sluiceway and headworks were opened on February 28, 1906, and the contract awarded to the contractors for Laguna Dam. Under the agreement of January 23, 1907, the United States assumed all work on this contract except the furnishing of the gates and other machinery. Orders for the remaining gates were given at a later date, and all sluice gates and regulating works were installed in the winter of 1908–9.

CANAL SYSTEMS.

The Gila Valley unit comprises 16,000 acres, of which 10,000 lie south and 6,000 north of the river. The Arizona main canal has been constructed for a distance of 4.7 miles below Laguna Dam. Work on this canal was commenced in April, 1909, and finished in February, 1912. The capacity is 250 second-feet and the yardage moved was 156,000. Connecting with this canal are 14 miles of laterals, which were built from April, 1911, to February, 1912, and January, 1913, to April, 1913. This system partially supplies a gravity area of 4,000 acres. In 1913 a pumping plant was installed, which can water an area of 2,000 acres. No construction work has been started in the South Gila Valley.

The construction of canals on the Yuma Indian Reservation was begun in June, 1908, and the first unit of the distribution system, comprising 39 miles of laterals, was completed in November, 1909, providing for the irrigation of 6,500 acres. This system has been extended to cover the 8,500 acres of Indian lands, and 36 miles of laterals have been built up to June, 1915.

The project main canal extends from Laguna Dam through the Yuma Indian Reservation to the Colorado River siphon, thence on the Arizona side to a point 1 mile below Yuma, a distance of 14½ miles, where it is divided into east main and west main canals. From Laguna Dam to the Indian Heading, a distance of 1½ miles, the canal was built by Government forces; the work was started in the fall of 1909 and finished in the spring of 1910. The canal has a capacity of 1,700 second-feet. A total of 229,000 cubic yards was moved. From the Indian Heading to the siphon spillway, a distance of 9 miles, the work was done by contract, beginning in November, 1911, and finishing in March, 1912. The canal has a capacity of 1,500 second-feet, a bottom width of 84 feet, and a depth of 7 feet. Approximately 1,300,000 cubic yards of material were moved. From the siphon spillway to the Colorado River siphon, a distance of 3 miles, the work was done by Government forces from April to June, 1911, and November, 1911, to May, 1912, and 366,000 cubic yards were moved. The canal from the Colorado River siphon to the junction of the east main and west main canals, a distance of 1 mile, was built by Government forces from February, 1912, to July of that year, and there were 184,000 cubic yards of earth excavation.

The Yuma Valley unit comprises 55,000 acres, and is watered by two main canals, the east main and west main, and a connecting lateral system. The east main canal follows the easterly side of the valley at the foot of the mesa and terminates near the Mexican boundary. Its capacity varies from 850 to 20 second-feet, and the largest section has a bottom width of 66 feet and a depth of 5 feet. Construction was commenced in November, 1911, by Government forces and finished in April, 1912; the earth excavation amounted to 638,000 cubic yards. The west main canal leaves the project main at the east main junction, follows the old San Diego boundary line west for 2½ miles, then runs southwest to the Yuma Valley levee, and then along the levee to the Mexican boundary, a total length of 25 miles. The largest channel carries 520 second-feet, with bottom width of 40 feet and depth of 5 feet. Work was commenced in January, 1912, and finished in May, 1915. The total earth excavation was 650,000 cubic yards. The lateral system was commenced in December, 1911. Up to June 30, 1915, a total of 209 miles of canals had been built and the distribution system was completed with the exception of a few minor extensions. Up to date the Yuma Valley distribution system has required 3,700,000 cubic yards of earth excavation and the building of 32 concrete and 1,603 wooden structures.

COLORADO RIVER SIPHON.

The construction of the shafts of the Colorado River siphon at Yuma was begun by the open-caisson method in the latter part of 1909. The line of the tunnel is about 350 feet downstream from the Southern Pacific Railroad bridge across the Colorado River. The siphon is designed to carry the water for a canal to serve 55,000 acres in the Yuma Valley and 40,000 on the Yuma Mesa, and has a capacity of 1,400 second-feet, passing this quantity with a loss of head of 2 feet. The original plans of the Yuma project did not contemplate a crossing under the Colorado River, the first plan being to bring the main canal down the Arizona side from Laguna Dam and cross the Gila River, but the siphon under the Colorado was decided upon after full consideration of the difficulties of the wide crossing which would have to be made on the Gila and the ultimate power development with a canal on the California side such as could be put in with the crossing under the Colorado. Borings along the proposed route of the tunnel indicated that soft sandstone, which outcropped at the left bank, was about 50 feet below the low-water bed in midstream and 80 feet under the surface at the California shaft. Overlying the sandstone there were at low water at least 25 feet of silt.

Preliminary operations at the Arizona shaft began in November, 1909. Sinking commenced on December 27, 1909, and the caisson arrived in position on June 5, 1910. Sinking of the California shaft began in January, 1910. Sinking was stopped at elevation 28 on September 30 of that year. During the sinking of the caissons the hard material surrounding the bottom portions was shattered for varying distances beyond the outer skin. This irregular annular space had become filled with fine sand and water, which it was necessary to consolidate before a tunnel could be driven out. Foundations in coarse sand and gravel had been constructed successfully by the injection of Portland cement grout under pressure, filling the voids and creating a hard, compact substance. This was tried at the Arizona shaft, but proved unsuccessful. Pending arrangements for future operations, the work at both shafts was shut down on February 21, 1911, and tenders for a pneumatic plant were asked. Contract was made for the use of compressed-air equipment, which arrived in May, 1911, and the Arizona shaft was sealed for this method of construction and the air applied the latter part of June. The tunnel entrance was made from this shaft and the tunnel driven all the way from the Arizona side until a connection was made with the California shaft. The pneumatic work continued without special incident for about one year, and water was turned through the siphon on June 29, 1912.

The entrance of the water to the siphon is controlled by a cylinder gate installed at the top of the California shaft. This shaft is 17 feet inside diameter; the tunnel, 950 feet long, has an inside diameter of 14 feet with 24-inch shell; and the Arizona shaft is 23 feet in diameter. The elevation of the bottom of the tunnel is 47½; the elevation of the water surface at the California side is 132 and at the Arizona side 130. There are 7,173 cubic yards of concrete in the completed structure; the work was without reinforcing, and steel plates were used on the outside of the arch of the tunnel. To date the structure has proved efficient, and no silting is evident.

LEVEES.

In order to prevent much of the irrigable land on the Yuma project from being flooded at times of high water, it was found necessary to construct about 75 miles of levees along Colorado and Gila Rivers. Proposals for the construction of about 10 miles of the Yuma Levee, along Colorado River below Yuma, were opened on August 17, 1905, and a contract for this work was executed in October, 1905. The work of construction for about 12 miles of levee was completed and accepted in March, 1906. This levee was extended about 1½ miles under informal contracts, the clearing and grubbing of this extension being done by Government forces. Further extensions of this levee were made by Government forces, and in May, 1908, it had been completed to the Mexican boundary, a distance of about 25 miles.

The Gila levees extend along the Gila River and construction was begun in March, 1906. After the completion of 5.6 miles of the south levee and 2.2 miles of the north levee the work was stopped until further observation indicated what effect the Gila floods would have upon these defensive works. The yardage moved was 339,804 cubic yards.

The Arizona Levee, extending along the east bank of the Colorado River from Laguna Dam to 5.5 miles south, was constructed between February and May, 1911; the earth excavation amounted to 319,100 cubic yards.

The Reservation Levee, which extends from Laguna Dam south along the west bank of the Colorado River, was begun in March, 1907, and completed in February, 1908. After this construction the Southern Pacific Co. laid a branch railroad on this levee from Yuma to Potholes, Cal., to facilitate transportation to the site of operations at Laguna Dam. The levee from Yuma west to Araz, Cal., was completed in May, 1915. The total yardage of the Reservation Levee from Potholes to Yuma, a distance of 12.5 miles, was 641,000 cubic yards, and the yardage of the west branch, from Yuma to Araz, a distance of 4.5 miles, was 226,000 cubic yards. To date the total yardage on all levee construction is 2,000,000 cubic yards.

RIVER-FRONT PROTECTION.

One of the most important problems on Yuma project is the prevention of river meandering, which is a menace to the levee system. The original relation of the river channel to the levees was such that the river was some distance from these embankments, and practically no work was necessary in protecting the levees until 1909. Since that time this work has constantly increased. At first the work consisted of light brush protections at the points of river attack. Later it was necessary to use steamboat and pile driver to drive piles for spur dikes which were protected against scour on their upper sides by brush mattresses. In 1912 the river attacked the reservation levee and it became necessary to dump rock to protect the bank from erosion. Rock was gotten from the Declez quarries, about 60 miles east of Los Angeles, and later the quarries at Laguna Dam on the California side ere opened. The railroad on the reservation levee proved to be absolutely necessary in this work.

During the high-water season of 1912 the Yuma Valley Levee was also threatened by the river cutting at several points, but by the liberal construction of spur dikes and brush protection the river was checked. In January, 1913, there was strong erosive action on the Arizona side of the river about 5 miles below Laguna Dam, and it was decided to attempt the protection of the levee there by the construction of abatti dikes. Two were built having a combined length of 1,800 feet. Shore revetment of brush and sand bags was placed. The results anticipated from these dikes were not realized and the succeeding flood undermined them and later destroyed them almost entirely. In Yuma Valley during the months of February and March, 1913, a temporary embankment comprising 27,000 cubic yards was built near the 17-mile post around the 1,800-foot break caused by the 1912 flood. In April, 1913, the river again attacked the reservation levee at a point about 3 miles below Laguna Dam and 150 feet of levee were washed out. It was decided that rock revetment was the only thing feasible to apply at this point, and equipment was immediately obtained to transport the rock from the quarries at Laguna Dam to the threatened points on the levee. Between April and August, 1913, 76,000 cubic yards of rock revetment were applied to 30,000 linear feet of levee, which successfully resisted the heavy flood of that year. Between January and March, 1913, it was necessary to place 9,000 cubic yards of rock revetment on the Arizona levee just below Laguna Dam.

In April, 1914, work was commenced on the Yuma Valley Railroad, beginning at block 169 in the city of Yuma, at which point a quarry was opened. The road was built from the quarry through the city to the Yuma Valley Levee near the Reclamation Service headquarters, thence on top of the dike to the Mexican boundary, a distance of 26.5 miles. The main purpose of the railroad was for river protection, but it has also been operated commercially to good advantage in bringing shipments of the farmers out of Yuma Valley. During 1914, 41,000 cubic yards of rock were placed. The earthwork moved in both railroad and temporary levee construction totaled 352,000 cubic yards. In February, 1914, camp was installed at Potholes; new quarters were built in some cases and the quarry opened up. From February to July of that year 97,000 cubic yards of rock were placed at the outlet of the California sluiceway and for levee revetment at the points of attack along the river front. In March, 1914, protection work was started on the Arizona side. A temporary track was laid across the dam for transporting a locomotive, dump cars, and material for building about 6 miles of railroad on the Arizona levee. Three spur dikes were built at right angles to this levee, with combined length of 5,900 feet. Earth excavation totaling 37,000 cubic yards and 58,000 cubic yards of rock were placed. Up to June 30, 1915, the river-front protection on the entire project has involved the placing of 380,000 cubic yards of rock, 570,000 cubic yards of earth excavation, and the building of 33 miles of railroad.

DRAINAGE.

It was concluded that under normal conditions drainage of the irrigated areas would be unnecessary during the early years of the project. In the Yuma Valley, and also on the Indian reservation, nature has practically laid down the main drainage channels, which should follow the large sloughs that traverse these tracts from end to end. Minor sloughs leading to the main ones aid greatly in the solution of local drainage problems. During the low stages of the river the main drainage channels may discharge into the Colorado River by gravity. At high stages pumping would be necessary. On the Yuma Indian Reservation, on the 6,500 acres which were opened to white settlers in 1910, the excessive use of water by inexperienced irrigators had so raised the ground-water plane that in the spring of 1911 it was apparent that construction of drains should be commenced. In February, 1912, work on the main drainage ditch was begun, and from that time until April 72,000 cubic yards of earth were moved. The channel has a bottom width of 14 feet and an average depth of 3 feet.

In addition to the rise in the ground-water plane, due to the excessive use of water, the high flood of 1912, which was of long duration, further increased the drainage problem, and extensive areas in the vicinity of the reservation levees were entirely under water and many crops were ruined. The ground water became so high that the use of drag-line scrapers was necessary in the construction work. Work was resumed on the main drain in January, 1913, and a drag line was installed. In April, 1913, a second drag line was installed. From November, 1913, to January, 1914, a total of 21,000 feet of closed drain was laid, comprising 15, 18, and 20 inch tile. Up to June 30, 1915, the drainage work has comprised 266,000 cubic yards of earth excavation on 11.5 miles of open drains, 21,000 linear feet of closed drains, 2,044 linear feet of cunettes, the installation of a drainage pumping plant one-half mile north of the Colorado River siphon, the building of structures, including 10 bridges, and the installation of test wells for the purpose of taking ground-water elevations. No injurious effects have yet been encountered in the Yuma Valley from a rise in the ground-water plane. For this area studies are now in progress and test wells located to secure data for the comprehensive system which will probably be needed before long.

CONSTRUCTION DURING FISCAL YEAR.

Canal system.—On the Yuma Indian Reservation, the entire distribution system was completed during the previous year, with the exception of a crossing of the main line of the Southern Pacific Railroad, and no construction work was necessary. On account of flood conditions on the project, the crossing was not completed. About 60,000 cubic yards of earth were moved in the lateral system on the Indian reservation north and south of the Southern Pacific main line in restoring lateral canals which were damaged by the Gila flood in January. About the same yardage was also excavated along the line of the main canal. In the Yuma Valley 10,000 cubic yards were excavated in building 1 mile of small laterals and in raising canal banks. Repairs to the canal system of the Yuma Valley, as a result of the January flood, consisted of about 30,000 cubic yards of earth work. Thirty small irrigation structures were built during the year and two ditch riders' houses, one at the 11-mile wasteway on the Yuma Valley levee and one at the town site of Gadsden. The distribution system of the Yuma Valley, which was practically completed a year ago, has made water available for all the irrigable lands of the valley. Of the total area, approximately 50,000 acres, or 50 per cent, are now in cultivation.

Levee system.—No new levee embankments were constructed during the year, the earth fills in the Indian reservation and Yuma Valley having been completed during the previous year. Considerable rock work, however, was in progress in the early months of the fiscal year and during the early spring following the unprecedented Gila flood which made necessary considerable restoration. Over 80,000 cubic yards of rock were placed for revetment purposes in the Indian Reservation levee and 134,000 cubic yards were used in protection work in the Yuma Valley. At the lower end of this valley, where the Yuma Valley Railroad line stops at the Mexican boundary line, a loop was built requiring 4,700 cubic yards of earthwork and 2,200 feet of track. Four small section houses were built along the line of the Yuma Valley Railroad to provide accommodation for patrolmen and the storage of equipment and supplies used on river work. In the Gila Valley about 9,000 cubic yards of rock were placed at the intake of the Arizona sluiceway and in revetting the ends of the dikes, whose purpose is to regulate the river channel. Preparations at Laguna Dam were made during the year properly to care for the large amount of water which the river was expected to discharge during the annual flood period. Rock from the Yuma quarry was obtained by a lease executed during the first part of the year to cover such requirements as could be estimated for the year's work. At Laguna Dam, the quarry room owned by the service was enlarged and a satisfactory face excavated, which developed a first-class quality of rock to be used on levee protection work where necessary. In the fall the large quantity of trees which had accumulated on the crest of the Laguna weir was removed, to prevent the forming of islands above and below the structure and a change of river location. To do this, a track was laid across the crest of the dam and rolling stock and other equipment transferred for use on the reservation and in Yuma Valley on levees. At the same time a large quantity of supplies and equipment was moved across for assemblement at the Yuma headquarters, where arrangements are in progress for the concentration of all equipment and supplies not in use on the project and where trackage has been provided into the headquarters grounds to facilitate the transportation and handling of such material.

DRAINAGE.

No further construction work was accomplished on the drainage system on the Indian reservation, on account of the necessity for obtaining a vote by the water users regarding the repayment of expenditures classed as supplemental construction. Preliminary plans were considered and some investigations carried on for the work proposed in Yuma Valley, where the lands are not yet under public notice. Some maintenance of the drainage system was in progress during the year on the Indian reservation, and the results obtained were successful in lowering the ground-water level to such an extent that the seepage was considerably less than in previous years.

ECONOMIES OF GOVERNMENT WORK.

Yuma Valley Railroad.—In mentioning this Government-operated railroad under the heading of economies of Government work, two fundamentals must be borne in mind: First, that the Yuma Valley Railroad was built on the Colorado River levee primarily as a means of hauling rock indispensable to the protection of this levee from river erosion, and, second, that in this district branch-line railroads are generally regarded, through actual experience by private companies, as cause for the most careful scrutiny as to their opportunities to earn enough to warrant the investment. The commercial success of the Yuma Valley Railroad, built on the levee, must, if at all, be worked out without interfering with the hauling of rock when it is necessary for the protection of the levee, and as the road is not run through a settled part of the project it is no exception to the rule that, even under ordinary conditions, it would be a matter of some concern to make it pay as a purely commercial business.

The service, being interested in the development of the Yuma Valley, has provided the best accommodation possible for the transportation of passengers and freight. During the latter part of January and the month of February, on account of the river work necessary and the large amount of rock hauled by the service over this road, there was considerable interruption to the commercial business until the construction work could be completed. It is to be understood, then, that the conditions of transportation were not entirely satisfactory to the farmers during that period, and what limited operations of the road were possible for commercial purposes were accomplished only with great difficulty. The farmers, who are more or less encouraged by the adequate service in times when no river protection work was necessary, were somewhat inconvenienced in their shipments when the use of the road was exclusively for the construction purposes. It is believed, however, that the operation of this road will continue to aid in the building up of the community, and will work toward the ultimate successful results in settlement and profitable operation of the road.

Ditch cleaning.—The irrigating water used on the Yuma project, coming from the Colorado River, deposits considerable quantities of silt when backed up in the irrigating canals, even though a large proportion of the silt is dropped in the settling basins at the Laguna Dam headworks. A year's run of water causes a deposit of silt in the ditches from 6 to 12 inches in depth, as well as depositing a layer on the sides, necessitating annual cleaning. The rank growth of grass and weeds in this warm country must also be taken in hand vigorously. The method formerly followed was to clean out the weeds and silt deposits by team and by hand, involving heavy unit costs, and the draining and partial drying of the ditches, to the detriment of the irrigators. It was with a view to avoiding the shutting out of the water for extended periods, as well as the question of cost, that made the installation of machinery desirable for this work, and a grader and caterpillar tractor were purchased and put into commission. After trying out this combination the grader was abandoned for the actual cleaning, as the water must be kept out of the canals for too long a period. However, the grader has proved of value in leveling the banks of the ditches after the dredges have gone through, as mentioned below, and piled the silt on the top of the banks.

A V was also used, the method being to run this kind of a plow on one side of the ditch at a time, hauled by the tractor, pushing the mud to the top and outward and leaving about a 1½ to 1 slope. Several miles of canal have been cleaned with fair success. Some changes can probably be made to advantage, and a new V is being built in the local shop along lines now thought best adapted to the work. In 1915 fifty miles of canal were cleaned by teams and hand at an average cost of $579 a mile. During the month of May, 1916, twelve miles of canal were cleaned with the caterpillar and V, and much better work accomplished, at an average cost of $55 a mile; and this cost is expected to be still further reduced with the use of the new V now under construction.

Additional drag-line excavators were purchased to be used on the larger irrigating canals, as well as on the drainage canals as formerly. The cost of handling the mud by this method is from 3 to 8 cents a yard, and this cost includes depreciation, repairs, supplies, and all other expenses. Present operation has been confined to the large main canals, but later the dredges will be used in ditches having as low as 36 second-feet capacity. It is estimated that the cost will be approximately $150 per mile, but these ditches will not have to be cleaned more than once in three years. The V has been used with good results in leveling the silt on the top of the banks after it has been placed there by the dredge.

GILA RIVER FLOOD OF JANUARY, 1916.

On January 22 and 30, 1916, the Colorado River gage at Yuma registered 34 and 30, respectively. The former carried a flood of 210,000 second-feet of water and the latter about 172,000 second-feet. This high water was due to the rapid rise of the Gila River, which joins the Colorado just above the town of Yuma. The gage height of 34, which is the highest known, and that of 30, following only a week afterwards, which is an extremely high-water surface, form a record-breaking flood season. The floods were the run-off of the

Gila River drainage area, which had been subjected to abnormal precipitation. The levee on the east of the town of Yuma was breached and the water ran through the lower part of the town during the first high stage on January 22. At this time also the levees of the Reclamation Service were topped in several places.

OPERATION AND MAINTENANCE.

The irrigable area of the project, as determined by the board reporting on October 24, 1914, comprises approximately 128,000 acres, divided into separate units, as follows: Yuma Indian Reservation, 15,000 acres, of which 6,500 have been opened to white settlers under public notice of January 12, 1910, the balance being divided among the Indians in 10-acre lots; Yuma Valley, 55,000 acres; Gila Valley, 15,000 acres; and the Yuma mesa, 40,000 acres. There were constructed on June 30, 1916, 332 miles of main canal and laterals, as follows: Project main canal from Laguna Dam to the siphon intake, 13.5 miles; Yuma Valley, 209 miles; Indian reservation, 75 miles, including 16 miles of drainage ditches; North Gila Valley, 18.5 miles; areas in South Gila Valley and Yuma mesa are not yet receiving water.

Historical review, Yuma project.

Item.	1911	1912	1913	1914	1915	To June 30, 1916.
Acreage for which service was prepared to supply water	16,000	16,000	50,000	60,000	71,200	72,440
Number of farms irrigated	447	470	616	698	737	768
Acreage irrigated	10,000	13,767	19,607	25,207	27,857	29,000
Miles of canals operated	157	163	228	272	307	310
Water diverted (acre-feet)	71,563	96,409	127,307	154,670	246,786	113,515
Water delivered to land (acre-feet)	54,346	63,273	85,411	93,167	92,897	45,957
Acre-feet per acre to area under cultivation	5.43	4.60	4.36	3.69	3.34	1.58

Pumping plants operated by the service during the fiscal year 1915–16.

Name of plant: Yuma Valley pumping plant.
Type: Gas engine, centrifugal.
Capacity of prime mover: 40 horsepower.
Number of units: 2.
Head pumped against: 4 feet.
First cost of plant: $900.
Acre-feet pumped: 758.
Cost per acre-foot: $0.928.

NOTES.—Plant is temporary installation and assembled from used equipment on hand. New unit expected to be built when use is more definitely determined.

Name of plant: Reservation drainage pump.
Type: Gas engine, centrifugal.
Capacity of prime mover: 110 horsepower.
Number of units: 2 engines, 2 pumps.
Head pumped against: 5 to 6 feet.
First cost of plant, $6,775.60.
Acre-feet pumped: 2,800.
Cost per acre-foot: $0.583.

NOTES.—Pump is used for discharging drainage water over levee on Indian reservation. Operation is intermittent.

SETTLEMENT.

Some impetus to settlement was present during the year and the acreage placed in crop was slightly in excess of the average for previous years. The Yuma Valley unit, having been completed, experienced during the year more growth and improvement than in previous years. The county authorities have begun the construction of a system of first-class roads in Yuma Valley, which has long been needed. This road improvement and the operation of the Yuma Valley Railroad have done much toward increasing the likelihood of early settlement. Good prices were obtained for the large alfalfa seed crop and other products of the valley. A number of land transfers were made, both on the Indian reservation and in the Yuma Valley, and from the outside a better class of settlers than heretofore has been attracted.

Settlement data, Yuma project.

Items.	1913	1914	1915	To June 30, 1916.
Total number of farms on project (when completed)	4,000	4,000	4,000	4,000
Number of farms reported	616	698	737	768
Population	1,663	1,815	2,036	2,086
Number of towns	3	3	4	4
Population	4,075	4,200	4,385	4,535
Total population of towns and farms	5,738	6,015	6,421	6,621
Number of public schools	13	14	15	16
Number of churches	6	7	7	7
Number of banks	3	3	4	3
Total capital stock	....	....	$170,000	$160,000
Total amount of deposits	....	....	$1,034,200	$896,450
Total number of depositors	....	....	2,322	(1)

[1] Data not available.

PRINCIPAL CROPS.

The principal crops raised on the project during the year 1915 were alfalfa hay, alfalfa seed, milo maize, Kafir corn, feterita, wheat, and barley. Cotton still proves to be a very profitable crop, and the acreage is increasing over previous years. Fruit and vegetables, although limited in amount, have continued to bring good prices, but the marketing facilities have not been organized sufficiently to bring in the returns which will undoubtedly come in future operations. In the vicinity of the new town of Gadsden a large acreage was planted to truck gardens and arrangements have been made to dispose of the product to southern Arizona mining companies, which formerly depended upon shipments originating in Mexico. The alfalfa-seed industry, which has been particularly profitable to the Yuma project farmers, continued to bring good results. Some increase was experienced in the cattle-feeding industry, which has provided a means for disposing of the alfalfa raised on the project.

Crop report, Yuma project, Arizona-California, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa hay	9,440	Ton	24,227	2.57	$7.15	$173,297	$18.36
Alfalfa seed	6,449	Bushel	27,817	4.31	8.96	249,331	38.66
Barley	1,572	...do	47,951	30.50	.66	31,924	20.31
Beans	324	...do	1,830	5.65	2.99	5,471	16.89
Indian corn	262	...do	5,900	22.32	.64	3,786	14.45
Corn sorghum	6,408	...do	231,185	36.07	.63	144,892	22.61
Cane and corn fodder	480	Ton	2,282	2.67	5.20	6,673	13.90
Cotton	709	Pound	359,850	507.55	.109	39,271	55.39
Cotton seed	709	...do	671,650	947.32	.006	4,395	6.20
Fruit	65					6,275	96.54
Truck	387					30,197	78.01
Hay, except alfalfa	774	Ton	1,110	1.44	8.95	9,937	12.83
Pasture	7,898					95,361	12.07
Wheat	2,267	Bushel	40,231	17.75	.83	33,211	14.65
Total	37,744						
Estimated additional revenue derived from pasturing, alfalfa, and stalk lands and feeding alfalfa straw after thrashing for seed						39,700	
Less duplicated areas	12,643						
Total cropped acreage	25,101	Total and average				873,721	34.81
Irrigated, no crop: New land and nonbearing orchard	2,756						
Total irrigated acreage	27,857						

Areas.	Acres.	Farms.
Total irrigable-area farms reported	39,146	737
Total irrigated-area farms reported	27,857	737
Under water-right applications	5,514	265
Under rental contracts	22,343	472
Total cropped-area farms reported	25,101	737

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, APRIL 7, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, notice is hereby given that hereafter until further notice for all lands under the Yuma project, California, the operation and maintenance charge for any irrigation season shall be due and payable on March 1 of the following calendar year.

2. The operation and maintenance charges for the irrigation season of 1916, and for each irrigation season thereafter until further notice, shall be due on March 1 of the following year, and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of $1.50, which will permit delivery of not more than 2 acre-feet per acre; and should further quantities be needed, they will be furnished at the rate of 75 cents per acre-foot.

3. The provisions of this public notice cover all lands subject to public notice heretofore issued for the said project.

4. Except as hereinabove provided, all the terms and provisions of existing public notices and orders and in particular the public notice of March 2, 1915, for the Yuma project shall remain unchanged.

Andrieus A. Jones,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, page 697.]

Feature costs of Yuma project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys		$171,209.95
Canal system:		
Preliminary and general	$167,856.10	
Diversion dam (Laguna)	1,751,027.20	
Headworks	352,334.25	
Main canal	541,871.15	
Siphon (Colorado River)	694,703.22	
Bridges	8,372.17	
Drops, chutes, checks	55,333.21	
Minor structures	573.86	3,572,071.16
Lateral system:		
Yuma Valley	979,001.48	
Reservation, Indian, north of railroad	94,853.96	
Reservation, white	265,874.34	
Reservation, Indian, south of railroad	1,279.09	
Gila Valley	153,595.39	
Mesa	645.08	1,495,249.34
Drainage system:		
Yuma Valley	6,412.34	
Reservation	146,619.42	153,031.76
Flood protection:		
Yuma Valley	1,162,265.42	
Reservation	738,962.06	
Gila Valley	396,186.96	2,297,414.44
Farm units		31,821.15
Permanent improvements and lands		149,380.68
Telephone system		10,384.61
Operation and maintenance during construction		572,234.76
Plant accounts		209,404.98
Gross construction cost to June 30, 1916		8,662,202.83
Less revenues earned during construction period:		
Rental of buildings	4,223.73	
Rentals of irrigation water	279,440.50	
Contractors' freight refunds	18,506.11	
Other revenues, unclassified	6.25	
Profit on mess-house operations	864.66	
Profit on mercantile store operations	66,451.65	
Profit on hospital operations	2,063.47	
Loss on railroad operations	[1]3,849.73	367,706.64
Net cost of construction of project to June 30, 1916		8,294,496.19

[1] Deduct.

Estimated cost of contemplated work, Yuma project, during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examination and surveys:		
Preliminary work	$1,000.00	
Topographic surveys	500.00	
Hydrographic surveys	150.00	
Hydrographic records	300.00	
Test borings or pits	1,000.00	
Designs	700.00	
		$5,000.00
Canal system:		
Headworks	19,600.00	
Main canal	5,800.00	
		24,500.00
Lateral system:		
Indian reservation	12,000.00	
Yuma Valley	42,945.00	
		54,945.00
Drainage system:		
Yuma Indian reservation	4,000.00	
Yuma Valley	117,000.00	
		121,000.00
Flood protection:		
Yuma Indian reservation levee	65,000.00	
Yuma Valley levee	109,000.00	
Gila Valley levee	15,000.00	
Roadbed	11,000.00	
		200,000.00
Farm units	....	2,000.00
Permanent improvements and land	....	30,000.00
Telephone system	....	2,000.00
Operation and maintenance during construction, water rental basis	....	120,000.00
Operation and maintenance under public notice	....	36,955.00
Messes	....	8,500.00
Mercantile stores	....	5,400.00
Hospitals	....	5,000.00
Total	....	615,300.00

CALIFORNIA, ORLAND PROJECT.

A. N. BURCH, project manager, Orland, Cal.

LOCATION.

Counties: Glenn and Tehama; reservoir and storage feed canal in Colusa County.

Townships: 21 to 23 N., Rs. 2 to 4 W., Mount Diablo meridian.

Railroads and other transportation lines: Southern Pacific Railroad and steamers on Sacramento River.

Railroad station and estimated population January 1, 1916: Orland, 1,500; railroad flag stations with freight sidetracks, Greenwood, Wyo, and Malton.

WATER SUPPLY.

Source of water supply, Stony Creek.

Area of drainage basin: Above project diversion dams, 735 square miles; above feed canal diversion dam, 97 square miles; above East Park Dam (Little Stony), 102 square miles.

Annual run-off in acre-feet: Stony Creek, near Fruto (601 square miles), 1907 to 1913—maximum, 940,000; minimum, 135,200; mean, 500,000. Little Stony Creek, at East Park Dam (102 square miles), 1907 to 1915—maximum, 170,800; minimum, 12,600; mean, 76,500.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916: 20,193 acres.

Area under rental contracts, season of 1916: 20,193 acres.

Length of irrigation season: From April 1 to October 31—214 days.

Average elevation of irrigable area: 250 feet above sea level.

Rainfall on irrigable area: 1883 to 1915—average, 17 inches; 1915, 28.07 inches.

Range of temperature on irrigable area: 26° to 114° F.

Character of soil of irrigable area: Sandy and gravelly loam, silt loam.

Principal products: Alfalfa, citrus and other fruits, and vegetables.

Principal markets: San Francisco, Cal.; Portland, Oreg.; eastern markets.

LANDS OPENED FOR IRRIGATION.

Dates of order and public notice: Order for fixing water-rental rate for 1916, April 26, 1916. Public notice opening for water-right applications all lands of project, May 24, 1916.

Location of lands opened: Tps. 21 and 22 N., R. 2 W.; Tps. 21, 22, and 23 N., R. 3 W.; Tps. 22 and 23 N., R. 4 W., Mount Diablo base and meridian.

Present status of lands opened: All in private ownership.

Limit of area of farm units: 40 acres, except that original subscribers are qualified to make water-right applications for an area not to exceed 160 acres.

Building charge per acre of irrigable land: $44.

Annual operation and maintenance charge will be based on the amount of water used, as provided by the act of August 13, 1914.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys made in 1906.

Construction recommended by board of engineers November 12, 1906.

Construction authorized by Secretary October 5, 1907.

First irrigation by Reclamation Service, season of 1910.

East Park Dam completed July, 1910.

Construction of East Park Feed Canal and second unit of the project authorized by Secretary July 25, 1913.

East Park Feed Canal completed June 30, 1915.

Entire project 98 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Orland project provides for the storage of water in a reservoir controlled by East Park Dam on Little Stony Creek, about 40 miles southwest of Orland, Cal., and a feed canal 7 miles long connecting the storage basin with Stony Creek. The diversion works for the feed canal are located about 3½ miles west of Stonyford. For the irrigation of lands in the vicinity of Orland water is diverted from Stony Creek into the canal systems at two points—namely, Miller Buttes, 9½ miles northwest of Orland, for the South Canal system, and at the north side weir, 5 miles northwest of Orland, for the North Side Canal system. The South Canal system is to irrigate 13,000 acres on the south side and the North Canal system 7,000 acres on the north side of Stony Creek. The stored water is conveyed from East Park in the natural creek channel 41 miles to the Miller Buttes diversion and 45 miles to the north side weir, where it is taken out in distribution systems comprising 138 miles of canals and laterals. The plan also includes a high-line canal from which power may be developed for pumping. The United States intends, for and in connection with the project, to use the waste, seepage, spring, and percolating water arising within the same, and asserts a right thereto by virtue of its reservation of all unappropriated waters of the project source of supply and of its appropriation of said waters in accordance with the State law heretofore made for the purposes of the project.

Work now under way includes placing rock riprap below the South Canal diversion weir, excavation of surface drains with construction of culverts and other structures, and placing concrete lining in certain sections of the lateral system.

The present limits of the Orland project may be considered as a unit of the Sacramento Valley project. It may be extended by constructing additional reservoirs on Stony Creek and its tributaries. The chief additional reservoir sites available are Millsite, on Stony Creek, near Fruto; Briscoe, on Briscoe Creek, near Elk Creek; Stonyford, on Stony Creek, at Stonyford; and Stony Gorge, on Stony Creek, near Elk Creek.

SUMMARY OF GENERAL DATA FOR ORLAND PROJECT TO JUNE 30, 1916.

Areas:			
Irrigable acreage when project is complete			20,193
Private land, June 30, 1916			20,193
Acreage service could have supplied season of 1915			20,193
Estimated acreage service can supply July 1, 1917			20,200
Acreage actually irrigated, season of 1915			8,928
Acreage cropped under irrigation season of 1915			6,930
Crops:			
Value of irrigated crops, season of 1915			$220,422.00
Value of irrigated crops, per acre cropped			$31.81
Finances:			
Estimated cost of completed project			$888,800.00
Total construction cost to June 30, 1916			$869,080.31
Per cent complete, June 30, 1916			98
Appropriation for fiscal year 1917, total			$56,000.00
Allotment for construction, fiscal year 1917			$28,700.00
Estimated per cent complete, June 30, 1917			99
Announced construction charges per acre			$44.00
Appropriation, fiscal year 1916			$87,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$55,114.40		
Transfers	4,767.82		
		$59,882.22	
Registered liabilities chargeable to 1916 appropriation		4,156.83	
			$64,039.05
Unencumbered balance July 1, 1916			$22,960.95

Repayments:

Water-rental charges—	
Accrued to June 30, 1916	$95,818.60
Collected to June 30, 1916	$95,818.60

Drainage:

Estimated acreage damaged by seepage to June 30, 1916	None.
Miles of drains built to June 30, 1916: Open	1.1
Cost of drainage works to June 30, 1916	$804.59

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

EAST PARK DAM, SPILLWAY, AND DIKES.

East Park reservoir is formed by East Park Dam across Little Stony Creek, Gordon Dike across a depression about 2,100 feet south of the dam, and Coleman Dike across a depression about 3,000 feet south of the dam. A spillway a short distance north of Gordon Dike provides for the discharge of surplus waters into a channel that leads back to the creek and two outlet conduits through the dam provide for the release of water from the reservoir.

Proposals for the construction of East Park Dam, spillway, and dikes were opened on August 27, 1908, and a contract for the work was executed on October 5, 1908. The contractor began to prepare for construction in November, 1908, but was soon obliged to suspend work for the winter. Operations were resumed in May, 1909, the placing of concrete was begun September 1, 1909, and the work was finished in June, 1910.

Between July 1 and December 15, 1911, an apron was added to the East Park spillway. This work was done by Government forces and involved the excavation of 11,000 cubic yards of rock and shale and the placing of 1,600 cubic yards of concrete.

DISTRIBUTION SYSTEM.

South Canal.—Satisfactory terms for the purchase on September 14, 1907, of the Stony Creek Irrigation Co. Canal were arranged, and in August, 1908, the construction of diversion works for that canal (now the South Canal) was commenced. This work, so far as then planned, was completed in November, 1908.

Beginning in October, 1910, the South Canal below Hambright Creek was rebuilt by Government forces. This work included 35 concrete structures and was completed in April, 1911.

North Canal.—In 1913 a diversion weir for the North Canal (the old Lemon Home Canal, purchased on September 27, 1907) was built, the old canal rebuilt, and the old wooden structures replaced with concrete. Also two pipe lines were built during the year. This work was done by Government forces.

First unit.—In March, 1909, the taking of topography for the irrigable area and the laying out of the distribution system for the project were begun.

Advertisements were issued on August 25, 1909, inviting proposals for the construction of the first unit of the distribution system, covering 10,000 acres. Contracts were awarded in October covering this work, which included about 200,000 cubic yards of earth excavation. The work was completed in August, 1910.

All structures for the distribution system for the original 14,000-acre unit were completed by Government forces by the close of 1912.

On April 1, 1914, advertisements were issued for earthwork construction for the extension of the distribution system, and on June 12 the contract was awarded to W. H. Mason. This contract involved 115,000 cubic yards of excavation and was completed October 31, 1914. The structures for this portion of the distribution system were built by Government forces and completed April 1, 1915.

East Park Feed Canal.—The very decided shortage in run-off from the watershed of the East Park storage basin during the seasons of 1911–12 and 1912–13 made it evident that some auxiliary source of storage should be provided. Accordingly, in the spring of 1913 a reconnaissance was made to determine the most feasible source for this additional water supply. The plan determined upon was the construction of a feed canal from Big Stony Creek to the East Park basin, thereby tapping the main watershed of the upper creek. Accordingly final surveys were made and designs completed, and on July 24 the results were submitted to a board of engineers composed of D. C. Henny, consulting engineer; E. G. Hopson, supervising engineer; and A. N. Burch, project manager. On the findings of this board the Secretary of the Interior approved the work, which carried with it not only the building of the feed canal but an increase in the capacity of the East Park reservoir and the addition of 6,000 acres to the project. Bids for the excavation of the feed canal were opened on October 15 and the contract was awarded to Philip Schuyler on November 18, 1913. During December of that year the contractor assembled equipment and cleared the right of way for the canal. The work, which involved 223,000 cubic yards of excavation, was completed on November 16, 1914. On March 13, 1914, advertisements were issued calling for bids for building the diversion dam and structures for the feed canal; the contract was awarded to M. Fischer on May 29. This feature of the work, involving 11,500 cubic yards of excavation and 4,550 cubic yards of concrete, was completed in February, 1915.

Canal lining.—Beginning with the year 1913 and extending to the close of the current fiscal year 218,400 square yards of concrete lining were placed by Government forces in the canals and laterals of the project.

CONSTRUCTION DURING FISCAL YEAR.

South Canal.—In August, 1915, by authorization of the director and chief engineer, the work of completing the headworks for the South Canal by extending a diversion dam across Stony Creek was commenced. Because of delay in obtaining materials work was suspended during the flood season and will be completed during the low-water period of the current year.

Beginning in the fall of 1915 the enlarging of the upper 4 miles of the South Canal and its structures was undertaken by Government forces and was completed at the close of the present fiscal year. This work was made necessary on account of the extension of the project and was done according to the plans formulated in connection with increasing the storage at East Park reservoir.

On December 15, 1915, bids were opened for the relocation of a part of the old Stony Creek Canal (now the South Canal), and the contract was awarded to A. Hawkins, who completed the work in April, 1916.

The following construction work was accomplished during the year 1916:

Canal system:		
Excavation	cubic yards	20,378
Concrete	do	443
Riprap	do	1,074
Piling	linear feet penetration	5,466
Steel flume (No. 192 Hess)	linear feet	306
Fencing	rods	212
Lumber in place	feet b. m.	41,541
Lateral system:		
Excavation	cubic yards	484
Minor structures, concrete	number	38
Fencing	rods	220
Concrete lining (1½ inches thick)	square yards	87,073
Revetment, brush	linear feet	600
Flood protection, riprap	cubic yards	241
Surface Drainage:		
Excavation	do	996
Open drains	miles	1.1
Structures	number	20

SEEPAGE AND DRAINAGE.

The drainage conditions on the project are very favorable. In general the soil is porous, is entirely free from deleterious salts, and has good surface and subsurface drainage. Practically the only way the land could be water-logged seriously would be by the excessive use of water by the farmers without provision for surface drainage. The danger from this source, however, is lessened by the provision of the extension act, which bases the operation and maintenance cost on the amount of water used. No serious water-logging of land or rising of the ground water has occurred. The land under the project is well provided with natural drainage channels, and with proper care of these channels by the landowners when they prepare their land for irrigation practically all danger of water-logging will be obviated.

The drainage plans for the project provide for the coordinating of this work with the landowners as agricultural development advances, the problem consisting primarily of taking care of storm water during the winter season, provision for which will provide incidentally for any needed drainage during irrigation seasons. As most of the project requires very little of this work, other than what should be done as a part of the regular work that the landowners must do in preparing the land for irrigation, the project can handle the situation best and most economically in cooperation with the landowners as farm development proceeds. This work was commenced during 1916 and will be pursued as occasion arises, a small amount of funds for the purpose having been provided in fixing the building cost of the project.

OPERATION AND MAINTENANCE.

The irrigation works operated in 1915 included the East Park Reservoir, the storage feed canal, and the north and south canal headworks, together with 115 miles of canals and laterals and 45 miles of natural channel. About 1,500 structures of various types were in use in operating the system.

Historical review, Orland project.

Item.	1912	1913	1914	1915	1916[1]
Acreage for which service was prepared to supply water	14,200	14,300	14,300	20,198	20,198
Acreage irrigated	4,230	6,617	7,354	8,928	10,000
Miles of canal operated	88	91	93	115	125
Water stored (acre-feet)	25,000	14,800	45,600	48,000	48,000
Water diverted (acre-feet)	34,000	40,500	50,000	52,000	60,000
Water delivered to land (acre-feet)	16,702	19,850	30,000	30,300	30,000
Per acre of land irrigated (acre-feet)	3.97	3.00	4.08	3.4	3.00

[1] Estimated.

SETTLEMENT AND DEVELOPMENT.

On the whole the project was fairly prosperous, although during part of the year business was somewhat depressed. Money for farm development throughout the whole year was difficult to obtain. The estimated investment in farm buildings and improvements during the year was $122,673, which exceeds that of any other year except 1913. There were 55 new farms brought under irrigation during 1915, and the increase of population on irrigated farms was 225. The average per farm was 3.6 persons for the irrigated area.

Dairying continues to be the paramount industry of the project, with an estimated output of 700,000 pounds of butter during the calendar year. The second creamery on the project began operations early in the year. Both of the creameries of the project are owned by local dairy interests and are conducted along cooperative lines. They are both housed in substantial concrete buildings, have extensive cold storage and ice plants, and are equipped with modern machinery.

There were more sales of unimproved land than for the previous year and at somewhat lower prices. Prices ranged from $80 to $125 per acre, with the average about $110. There remained at the close of the fiscal year about 10,000 acres undeveloped.

The water rental charges were paid to the United States in a lump sum by the water users' association through the levying of an assessment of $1 per acre for all of the irrigable land in the project.

Settlement data, Orland project.

Item.	1913	1914	1915	1916
Total number of farms on the project	350	507	509	509
Population	950	1,100	1,600	1,700
Number of irrigated farms	246	296	351	360
Operated by owners	226	263	320	330
Operated by tenants	20	33	31	30
Population	896	1,033	1,258	1,400
Number of towns	1	1	1	1
Population	1,300	1,350	1,500	1,550
Total population	2,250	2,450	3,100	3,250
Number of public schools	6	8	8	8
Number of churches	5	5	6	7
Number of banks	2	2	2	2
Total capital stock	$110,000	$110,000	$141,000	$141,000
Total amount of deposits	....	$391,000	$395,000	$445,000
Total number of depositors	....	1,263	1,708	1,800

PRINCIPAL CROPS.

There were 351 farms irrigated in 1915, with an average irrigable area of 28.4 acres and an average cropped area of 20 acres. The total area irrigated was 8,928 acres, an increase of 1,574 acres over 1914.

There was an increase of 542 acres in alfalfa, but a larger acreage of alfalfa was devoted exclusively to pasturage than during 1914; 5,135 acres were cut for hay, yielding 22,650 tons, which, estimated at the market price for loose hay, was worth $153,322. Ninety per cent of the crop was consumed on the project in feeding dairy and other stock.

There were 375 acres of orchard in partial and full bearing and 1,000 acres not bearing. The total cropped area was 6,930 acres; the estimated value of crops $220,422, or $31.81 per acre, an increase of $4.82 per acre over the previous year.

An inventory of stock shows an increase during the calendar year of $80,000, most of which was in dairy stock and hogs. The increase of the former was 28 per cent and of the latter 66 per cent. The total estimated value of stock and equipment on hand on the farms at the close of the calendar year was $433,000, an increase of $90,000 for the year.

Crop report, Orland project, California, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa hay	5,135	Ton	22,650	4.4	$6.77	$153,322	$29.85
Alfalfa pasture	4,329					22,323	5.16
Beans	30	Bushel	349	12	2.92	1,021	34.03
Corn, sorghum	307	...do	10,544	34	.88	9.211	30.00
Fruit, citrus	113	Pound	292,200	2,586	.017	4,898	43.35
Fruit, deciduous	[1] 76	...do	184,000	2,421	.011	2,037	26.80
Fruit, small	16					2,204	137.75
Prunes, dried	40	Pound	110,000	2,750	.05	5,500	137.50
Almonds	130	...do	72,900	561	.103	7,512	57.78
Garden	96					6,794	70.77
Nursery	12					5,600	466.67
Less duplicated areas	3,354						
Total cropped acreage	6,930	**Total and average**				220,422	31.81

Crop.	Area (acres).	Areas.	Acres.	Farms.	Per cent of project.
Irrigated, no crop:					
Nonbearing orchard	1,019	Total irrigable area farms reported	9,971	351	48
Young alfalfa	542	Total irrigated area farms reported	8,928	351	44
Miscellaneous	437	Under rental contracts	8,768	349	43.2
		Under vested rights	160	2	.8
Total irrigated acreage	8,928	Total cropped area farms reported	6,930	351	34.1

[1] Small mixed orchards of apricots, peaches, apples, etc.

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, MAY 24, 1916.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplementary thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water is available from the Orland project, California, for the

irrigation season of 1916 and thereafter, upon the filing of proper water-right applications for the irrigable land shown on the following farm unit plats:

Mount Diablo base and meridian.
T. 21 N., R. 2 W.
T. 22 N., R. 2 W.
T. 21 N., R. 3 W.
T. 22 N., R. 3 W.
T. 23 N., R. 3 W.
T. 22 N., R. 4 W.
T. 23 N., R. 4 W.

approved by the Assistant Secretary of the Interior on May 24, 1916, and on file in the office of the project manager, U. S. R. S., Orland, California, and the local land office at Sacramento, Cal.

2. The maximum limit of area for which water-right application may be made for lands in private ownership shall be forty acres of irrigable land for each landowner except that water-right applications may be made for a maximum of 160 acres of irrigable land by those landowners who were original subscribers to the stock of the Orland Unit Water Users' Association and who are qualified by the terms of their excess land contract and trust deed with the Orland Unit Water Users' Association to apply for a water right for not more than 160 acres of irrigable land. Water-right applications for lands in private ownership may be made on and after the date of this notice. All water-right applications must be made to the project manager, U. S. Reclamation Service, Orland, California.

3. The water-right charges for the lands shall be of two kinds—(a) a charge of $44.00 per irrigable acre for the building of the irrigation system, termed the construction charge, the instalments for which are due and payable as hereinafter provided; and (b) an annual charge for operation and maintenance due and payable March 1 of each year for the preceding irrigation season. The first operation and maintenance charge will be for the irrigation season of 1917, the amount of which charge will be hereafter announced. The water service charges for the season of 1916 have been fixed in the Secretary's order of April 26, 1916.

4. For all of the irrigable lands on said plats which on or before August 13, 1914, were subscribed to the stock of the Orland Unit Water Users' Association or which otherwise became subject to the reclamation law on or before August 13, 1914, and for which acceptances under the terms of the reclamation extension act shall be duly filed within six months of the date hereof, the same being by means of either (1) a water-right application on the form provided for use under said reclamation extension act, or (2) a separate form of acceptance provided therefor, the construction charge shall be paid in 20 annual instalments, the first of which shall be due on December 1, 1916, and subsequent instalments on December 1 of each year thereafter until the construction charges are fully paid. The first four of such instalments shall each be 2 per cent, the next two each 4 per cent, and the next fourteen each 6 per cent of the construction charge.

5. For all of the irrigable lands on said plats which on or before August 13, 1914, were subscribed to the stock of the Orland Unit Water Users' Association or which otherwise became subject to the reclamation law on or before August 13, 1914, the owners of which

do not elect to file acceptances of the reclamation extension act, the construction charge shall be paid in ten equal annual instalments, the first of which shall be due and payable December 1, 1916, and subsequent instalments on December 1 of each of the succeeding years until the total construction charge is paid.

6. For all irrigable lands shown on said plats which became or may become subject to the reclamation law after August 13, 1914, an initial instalment of 5 per cent of the construction charge shall be paid at the time entry or water-right application is made, and the balance of the construction charge shall be paid in 15 annual instalments, the first 5 of which shall each be 5 per cent of the construction charge and the remaining 10 instalments each 7 per cent of the construction charge, until the whole amount of the said construction charge shall have been paid. The first of the 15 annual instalments shall become due and payable December 1 of the fifth calendar year after the initial instalment and subsequent instalments shall become due on December 1 of each year for fourteen years thereafter.

7. Any water-right applicant or entryman may if he so elects pay the whole or any part of the construction charges owing by him within a shorter period than those designated herein.

8. In all cases where water-right applications for lands in private ownership, or for lands held under entries not subject to said reclamation act, shall not be made within one year after the date of this notice the construction charge for such lands shall be increased 5 per cent each year until water-right applications and an initial payment are made.

9. All payments hereunder shall be made to the special fiscal agent of the Reclamation Service assigned to the project, unless under section 7 of the reclamation act the Orland Unit Water Users' Association is appointed as fiscal agent, of which due notice will be given.

10. The method of determining the annual operation and maintenance charge and the penalties for failure to pay the construction charge and the operation and maintenance charge when due and the discount allowed for prepayment of operation and maintenance charges will be as provided by the act of Aug. 13, 1914.

Bo Sweeney,
Assistant Secretary of the Interior.

ORDER, APRIL 26, 1916.

1. Under the provisions of section 11 of the reclamation extension act of August 13, 1914 (38 Stat., 686), the following order is issued for the Orland project, California:

2. Water will be furnished on a temporary rental basis during the irrigation season of 1916 at the following rates:

A rate of 10 cents per acre-foot for all water delivered prior to June 1 and at 40 cents per acre-foot for water delivered on or after June 1. A minimum payment of $1 per irrigable acre shall be made, whether water is used thereon or not.

3. The charges for the minimum rate for the entire irrigable acreage will be billed to the Orland Unit Water Users' Association, and shall be paid to the United States on or before July 15, 1916. Bills for water supply furnished in excess of the minimum charge of $1 per acre shall be submitted promptly after the end of July and

each month thereafter, and shall be paid by the Association within 15 days after the submission of such bills.

FRANKLIN K. LANE.

FINANCIAL STATEMENT.

(Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, page 699.)

Feature costs of Orland project to June 30, 1916.

Feature.	Subfeatures.	Principal feature.
Examination and surveys:		
Investigations	$3,582.79	
Hill meter installation	283.08	
Cippoletti weirs	229.20	
Rating weir, East Park Dam	214.28	
Preliminary and general work	96.62	
		$4,405.97
Storage system:		
East Park reservoir survey	4,060.84	
East Park Dam, spillway, and dikes	155,536.82	
East Park stripping reservoir, site	88,469.02	
Stonyford reservoir surveys	128.28	
Millsite	328.21	
East Park spillway extension	29,470.79	
East Park surveys for additional storage	4,271.62	
East Park feed canal	171,956.61	
		454,222.19
Canal system:		
South diversion dam and works	86,414.19	
North diversion dam and works	5,145.58	
North Canal	30,617.34	
South Canal	76,760.79	
Administrative general expense	1,214.16	
Miscellaneous structures	17,402.55	
		167,554.61
Lateral system:		
Northside lateral excavation	31,643.95	
Southside lateral excavation	51,017.61	
Concrete lining	73,232.76	
Revetment	84.20	
Minor structures	45,215.24	
Administrative general expense	791:98	
Miscellaneous structures	16,959.08	
Extension lateral 12	3,365.89	
Puddling	695.89	
Location surveys	2,462.78	
Railroad crossing	6,251.43	
Enlarging lateral 100	1,058.65	
		232,778.96
Drainage system:		
Open drains	762.90	
Administrative general expense	41.69	
		804.59
Flood protection:		
Levees and dikes	492.85	
Administrative general expense	6.87	
		499.72
Farm units:		
Preliminary and general work	1,329.90	
Administrative general expense	30.69	
		1,360.59
Permanent improvements and land:		
Buildings	7,635.08	
Headquarters grounds	6,862.88	
Miscellaneous	271.72	
		14,769.68
Operation and maintenance during construction	....	99,154.23
Plant accounts	....	987.94
Gross cost of construction of project to June 30, 1916	....	976,538.48
Less revenues earned during construction period:		
Rental of buildings	984.00	
Rental of grazing and farming lands	3,217.00	
Rentals of irrigation water	95,818.60	
Contractors' freight refunds	1,829.82	
Forfeitures by defaulting bidders and contractors	2,115.00	
Other revenues, unclassified	1,787.51	
Profit on mess-house operations	14.97	
Profit on hospital operations	703.33	
		106,470.23
Net cost of construction of project to June 30, 1916	....	870,068.25

Estimated cost of contemplated work, Orland project, during fiscal year 1917.

Features.	Subfeatures.	Principal features.
Storage works: East Park Dam outlet works, one 36 by 36 inch outlet gate	$1,200.00	$1,200.00
Canal system: South Canal diversion dam, complete riprapping	3,000.00	3,000.00
Lateral system:		
Extension lateral 12	1,200.00	
10 minor structures	300.00	
30,000 square yards concrete lining	12,000.00	
		13,500.00
Drainage system: Open drains and drain structures	2,000.00	2,000.00
Operation and maintenance during construction:		
Development	1,428.00	
Distribution	7,950.00	
Miscellaneous	3,622.00	
		13,000.00
Operation and maintenance under public notice:		
Development	1,572.00	
Distribution	8,750.00	
Miscellaneous	3,978.00	
		14,300.00
Hospitals		500.00
Total		47,500.00

COLORADO, GRAND VALLEY PROJECT.

J. H. MINER, project manager, Grand Junction, Colo.

LOCATION.

County: Mesa.

Townships: 1 N., Rs. 1 E. and 1 to 3 W.; 2 N., Rs. 2 and 3 W.; 1 S., Rs. 1 E. and 1 W., Ute meridian. 9 S., Rs. 101 to 104 W.; 10 S., Rs. 98, 101, and 103 W.; 11 S., Rs. 98 and 99 W., sixth principal meridian.

Railroads: Denver & Rio Grande; Colorado Midland.

Railroad stations and estimated population, January 1, 1916: Palisade, 700; Clifton, 100; Grand Junction, 8,250; Fruita, 700; Loma, 70; Mack, 40.

WATER SUPPLY.

Source of water supply: Grand River.

Area of drainage basin: 8,550 square miles above Palisade.

Annual run-off in acre-feet of Grand River, at Palisade, 1897 to 1899 and 1902 to 1915: Maximum, 5,230,000 (1912); minimum, 2,300,000; mean, 3,780,000.

Discharge in second-feet of Grand River, at Palisade, 1902 to 1915: Maximum, 43,400; minimum, 1,102.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the Service is prepared to supply water, season of 1916: 14,500 acres.

Area under rental contracts season 1916 (to June 30): 2,576 acres.

Length of irrigation season: From April 1 to October 31, 214 days.

Average elevation of irrigable area: 4,700 feet above sea level.

Rainfall on irrigable area: For 23 years, average, 8.31 inches; 1915, 8.45 inches.

Range of temperature on irrigable area: —15° to 100° F.

Character of soil of irrigable area: Sandy loam, sandy mesas, and adobe.

Principal products: Fruit, sugar beets, alfalfa, grain, vegetables.

Principal markets: Large cities east of Rocky Mountains for fruit; other products, local.

LANDS OPENED FOR IRRIGATION.

No lands have been opened for irrigation by public notice. All lands irrigated in the project are supplied with water under rental contracts.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys begun in September, 1902.

Construction recommended by board of engineers December 15, 1908.

Purchase of rights of way authorized by Secretary November 4, 1911.

Construction authorized by Secretary September 23, 1912.

First irrigation by Reclamation Service, season of 1915.

Entire project 61.5 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Grand Valley project provides for the diversion of water from the Grand River by means of a diversion dam located about 8 miles northeast of Palisade, Colo., into a canal system on the north side of the river for the irrigation of lands lying north and west of Grand Junction, Fruita, and Mack, Colo. About 42,750 acres will be supplied by gravity and 10,250 acres by electrically operated pumping plants to be located on the gravity canal.

Power for pumping will be developed in a power plant to be located at the upper portal of Tunnel No. 3. On the first 6 miles of the main canal located in the canyon of the Grand River there are three tunnels, respectively, 3,723, 1,655, and 7,292 feet long The United States claims all waste, seepage, spring, and percolating water arising within the project, and proposes to use such water in connection therewith.

On June 30, 1916, the diversion dam and head works were 99 per cent completed, and the earthwork, tunnels, and structures on the first 37 miles of the main canal were completed. On the next 18 miles of the main canal the earthwork was completed and the structures were 50 per cent completed. Laterals to cover 14,500 acres in the first lateral district were 96 per cent completed, and laterals to serve 10,000 acres in the second lateral district were 85 per cent completed.

There remain to be completed the last 7 miles of the main canal, laterals for 15,500 acres in the second and third lateral districts, the power plant and pumping system, and such drainage and flood-protection works as may be required.

SUMMARY OF GENERAL DATA FOR GRAND VALLEY PROJECT TO JUNE 30, 1916.

Areas:			
Irrigable acreage when project is complete			53,000
Public land entered, June 30, 1916		9,880	
Public land withdrawn, June 30, 1916		20,190	
Private land, June 30, 1916		22,930	
Addition in fiscal year, 1916			14,500
Estimated addition in fiscal year, 1917			20,500
Estimated acreage Service can supply July 1, 1917			35,000
Finances:			
Estimated cost of completed project			$4,595,000.00
Total construction cost to June 30, 1916			$2,824,539.23
Per cent complete, June 30, 1916			61.5
Appropriation for fiscal year 1917, total			$520,093.95
Allotment for construction, fiscal year 1917			[1] $255,000.00
Estimated per cent complete, June 30, 1917			72.8
Appropriation, fiscal year 1916			$702,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$276,946.75		
Transfers	19,400.94		
		$296,347.69	
Registered liabilities chargeable to 1916 appropriation		56,105.71	
			$352,453.40
Unencumbered balance, July 1, 1916			$349,546.60
Drainage:			
Estimated acreage damaged by seepage to June 30, 1916			275
Miles of drains built to June 30, 1916: Open			0.7
Estimated acreage protected by drains built to June 30, 1916			50
Expended to June 30, 1916, on drainage works, completed and uncompleted			$2,318.03

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

ORIGIN OF PROJECT AND INVESTIGATIONS.

In the valley of Grand River in western Colorado, for a few miles above and below the mouth of Gunnison River, irrigation has been practiced since 1883, and more than 50,000 acres of land are being watered by various canal companies, irrigation districts, and private canal lines. The supply of water in Grand River is sufficient for irrigating much greater areas, and plans had long been under consideration by private parties for the construction of a suitable canal for supplying the higher lands along the valley. Surveys were made as early as 1897 by Mr. C. D. Page, of Greeley, Colo., for determining the location of such a canal line, and other investigations and surveys were made by various parties.

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[1] Does not include amount held in suspense; total available allotment is 80 per cent of appropriation, or $416,075.

In June, 1902, investigations of irrigation possibilities in Grand Valley were ordered by the chief engineer of the Reclamation Service. During the season of 1902 and the winter of 1902–3 topographic surveys of portions of the canyon of Grand River and of adjacent areas in which possible canal routes might be found were made. On June 10, 1903, a board of engineers, consisting of Messrs. A. P. Davis, G. Y. Wisner, and W. H. Sanders, after investigation of the project and examination of the maps and reports of surveys, recommended the survey of a canal line designed to water about 51,000 acres of land, 7,000 acres of which were at that time irrigated by a private pumping system, and the balance of which were unirrigated. Further surveys were postponed, however, on account of the contemplated construction of canals by private capital and the formation under the laws of the State of Colorado of an irrigation district embracing some of the lands that might be irrigated by the proposed Government canals. After efforts had been made to arrange for construction by sale of bonds of the irrigation district a meeting, largely attended by the water consumers of the district, was held on October 3, 1904, at which resolutions were adopted requesting the Government to construct the project for the benefit of the irrigation district already incorporated, proposing the formation of a water users' association, and requesting conferences with officers of the Reclamation Service regarding possible construction plans. Other letters and petitions from citizens in the valley urging the Government to undertake the construction of an irrigation project were also received. The Grand Valley Water Users' Association was organized and incorporated on February 7, 1905, and took active steps to secure the construction of the project by the Reclamation Service.

In August, 1907, the Secretary of the Interior ordered further investigation and report to be made on the cost and feasibility of the project. After consideration of this report, the Secretary requested an expression of the wishes of the people of the valley in regard to the construction of the project by the Reclamation Service. The sentiment, as expressed in public meetings, being strongly in favor of Government construction, the Secretary authorized the Reclamation Service to proceed with surveys, preparation of plans, and acquisition of rights of way, and on December 13, 1907, made an allotment of $50,000 for the purpose of carrying on the work.

In February, 1908, field investigations were resumed. During the season of 1908 topographic surveys and soil classification of the irrigable area were completed, a site was selected for the diversion dam in the Grand River, about 8 miles northeast of Palisade, Colo., and final location made of the first 32 miles of the main canal. Designs for the more important structures were drawn up, and estimates covering the entire project were prepared. In December, 1908, a board of engineers consisting of W. H. Sanders, J. H. Quinton, William Gerig, I. W. McConnell, and E. E. Sands convened to consider the plans for the project. Under date of December 15, 1908, this board approved the general plan of the project as outlined by the project engineer. This involved the construction of a movable crest diversion dam across the Grand River and a main canal 65 miles in length to cover 53,000 acres of irrigable land on the north side of the river. The board outlined the policy to be adopted on various matters in connection with the development of the project and recommended that construction work be undertaken and prosecuted as fast as available funds would permit. It was not considered feasible to locate the canal high enough to avoid the orchards in the Mesa County irrigation district.

Early in 1909 steps were taken to acquire the necessary rights of way, and negotiations were taken up with the Palisade and Mesa County irrigation districts looking toward their inclusion in the project and the transfer of their power-water rights to the United States. On February 20, 1909, the Secretary executed a contract with the water users' association providing for the beginning of construction work under the cooperative plan. Preparations were made to undertake the construction of Tunnel No. 3 by Government forces, and advertisement was issued by the association for the excavation of a portion of the main canal. Further representations were made, however, by certain interests in favor of the construction of the project by private capital, and all construction work was suspended in May, 1909, by order of the Secretary. Public meetings were held at this time in which resolutions were passed strongly favoring Government construction.

Meantime opposition had developed against the proposed location of the main canal through the improved orchard lands of the Mesa County irrigation district, and detailed investigations were undertaken to determine the feasibility of locating the canal on a line about 20 feet higher in order to avoid these improved lands. In the fall of 1909 final location of the first 8 miles of the higher line was staked out and paper location made of the remainder. Plans were drawn up for the principal structures, and comparative estimates of the project, based on each of the proposed locations, were prepared. On September 18 and 19, 1910, the board of Army Engineers visited the project, and in their report, issued January 6, 1911, recommended that the original lower line canal location be adopted, and also recommended that the construction of the project be undertaken conditional upon a satisfactory showing of water rights.

Early in 1911 negotiations were resumed with the Mesa County and Palisade irrigation districts. On May 31, 1911, the districts submitted a proposition to transfer their power rights to the Government, to pay $20 per acre for a water right under the Government system, and to supply canal right of way through the districts free of charge to the United States, provided the main canal for the project should be divided and built on the locations of the existing distribution canals of the district. Preliminary surveys and estimates covering this scheme were prepared, and maps of the necessary rights of way were submitted to the districts. Opposition to this plan developed, however, and the districts failed to carry out their part of the agreement.

Active steps were then taken to secure the rights of way on the location approved by the Army board, and by June 30, 1912, about 90 per cent of this right of way was covered by agreements to sell. On April 17, 1912, a board of engineers consisting of A. P. Davis, L. C. Hill, R. F. Walter, and J. H. Miner approved the location and designs of the project main canal, and recommended that further overtures be made to the two irrigation districts for the transfer of their water rights. On June 28, 1912, a board composed of A. P. Davis, D. C. Henny, R. F. Walter, and J. H. Miner recommended that the districts be allowed until August 1 to consider the proposals for their inclusion in the project. The districts failed to take favorable action in this time, and plans for the main canal were therefore revised so that the acquisition of the districts' power water rights would not be essential to the success of the project. The location of the proposed power plant was shifted to the upper portal of Tunnel No. 3 to permit the return of waste water from the project power plant to the Grand River at a point above the diversion dam of the two irrigation districts. The capacity of the canyon division was increased from 1,200 to 1,425 second-feet to offset the reduced power head.

On September 23, 1912, a contract with the Grand Valley Water Users' Association providing for the repayment of the cost of the project was provisionally approved by the Secretary of the Interior, and on the same date the construction of the project was authorized. The final draft of contract with the water users' association was executed by the Secretary on February 13, 1913. The first few miles of the main canal in the canyon of the Grand River closely parallel the track of the Rio Grande Junction Railway (leased by the Denver & Rio Grande and Colorado Midland Railroad Companies), and a portion of the canal is located on the railroad right of way. Negotiations were taken up with the railroad companies in July, 1912, for the desired concessions, and on August 27, 1913, a contract was executed providing for the occupation by the United States of various portions of the railroad right of way, for raising the railroad grade near the headworks, and for the construction of a bridge at the crossing of the railroad over the canal.

GRAND RIVER DIVERSION DAM.

Description of dam.—The diversion dam and headworks for the Grand Valley project are located on the Grand River about 8 miles northeast of Palisade, Colo. The dam consists of a solid concrete weir resting on gravel foundation, surmounted by eight massive piers and provided with seven roller crests for regulating the height of backwater at the canal intake. Six of the roller crests span openings 70 feet long between piers and are 10 feet 3 inches in height. The seventh roller is 60 feet long, 15 feet 4 inches in height, and will regulate the flow through the sluiceway in front of the canal intake. The movable crest adopted for this structure was necessary in order to avoid raising the height of backwater during flood to such elevation as would interfere with the adjacent track of the Rio Grande Junction Railway. At times of low flow the dam will divert into the project canal the full flow of the river, part of which, however, will be returned through the power plant at the lower end of the canyon division. Nine gates, each with an opening 7 feet square, regulate the flow into the canal. The roller crests and regulator gates are operated by electric motors, supplied with current from a gasoline-electric generator set, and storage batteries, to be located in the power house at the west abutment of the dam. The crests and gates can also be operated by hand if necessary. Concrete houses on alternate piers shelter the motors and hoisting machinery. A three-hinged arch steel service bridge, 6 feet in width, consisting of seven spans, extends the full length of the dam.

Approval of plans.—A general plan for the dam and headworks was completed in July, 1913, and was reviewed by a board consisting of R. F. Walter, J. H. Miner, F. Teichman, and O. T. Reedy, who reported on July 26. This design was tentatively approved by the director, and the construction of the dam by Government forces was approved by the Secretary of the Interior on August 19, 1913. Detail plans for the canal regulator gates were next prepared, and bids for the fabrication of the metal work were opened on October 15. Contract for this work was awarded to the Hinman Hydraulic Manufacturing Co., of Denver.

Construction program.—The erection of camp buildings was commenced on August 25 and a force organized to undertake the construction of the dam and headworks. The proposed construction program contemplated the completion of the sluiceway and headworks during the winter of 1913–14 and then turning the entire flow of the river through the sluiceway channel. A cofferdam would then be constructed across the river, unwatering the foundations for the weir and permitting the excavation and concreting of the main portion of the dam to proceed without interruption.

Canal intake and sluiceway.—The excavation for the canal intake and sluiceway was begun on August 27, 1913, and completed in April, 1914. The excavated material consisted principally of cobblestones compactly bedded in gravel. In October a railroad siding was installed, and camp buildings were completed. A temporary concreting plant driven by a gasoline engine was erected at the west end of the dam for placing the concrete in the sluiceway and regulator gate walls. The first concrete was placed January 9, 1914. Concrete work on the sluiceway and intake was completed on May 23, 1914. Sand and gravel for this concrete were obtained from beds adjacent to the river. The installation of the regulator gates was completed in April. A temporary pile footbridge across the river, which was later used in depositing material in the main cofferdam, was completed in March. On June 3, 1914, a flood flow of 43,000 second-feet passed down the Grand River without damage to the pile bridge or the completed work.

Main construction plant.—Work on the installation of the main construction plant was started early in 1914. A 10-ton cableway 920 feet long was erected over the axis of the weir. A power substation and a crushing, screening, and concrete-mixing plant were installed at the east end of the dam. This plant consisted of a gyratory crusher, sand rolls, a bucket elevator, revolving screens, sand and gravel bins, and a 30-cubic foot mixer; all machinery was driven by electric motors. Concrete aggregate was obtained from a sandstone quarry opened in the face of the cliff adjacent to the plant. The material from the quarry was handled by a derrick and the overburden was used in the main cofferdam. The substation consisted of a battery of three 75-kilowatt transformers, stepping down 16,500-volt current, operating a 150-kilowatt 2,300-volt motor, direct connected to a 100-kilowatt generator which furnished 250-volt direct current to operate all motors on the work. The substation was put into operation on May 22, 1914. All power was supplied from a central power plant located at Cameo, which also furnished power for the construction of the tunnels of the main canal.

Excavation for foundation and cut-offs.—The high-water flow of 1914 continued exceptionally late in the year and necessitated postponing until the latter part of August the completion of the main cofferdam and diversion of the flow of the river through the completed sluiceway. In September excavation for the foundation and the cut-offs of the main weir was undertaken, using teams in the west part and a drag-line outfit at the east end. This excavation was delayed somewhat by heavy rains which caused an unprecedented flood on October 3, 1914, overtopping and washing out a portion of the cofferdam. Excavation for the cut-off walls was carried over into firm, cemented gravel or to the underlying shale. Placing of concrete in the weir and piers was begun late in October. The weir was completed and the piers were carried up to an elevation above high water during the winter and spring of 1915.

Roller crests.—Contract had previously been entered into with the German patentees for the manufacture of the roller crests, but this contract was canceled on account of the European war. The rollers were redesigned in American shapes, advertisement issued, under Specifications No. 285, and contract entered into with the Riter-Conley Co., of Pittsburgh, Pa., for the fabrication of the same. Contract for the hoists for the 70-foot rollers was awarded to the Minneapolis Steel & Machinery Co., and for the 60-foot roller hoist to the Link Belt Co., of Chicago, under Specifications Nos. 286 and 294, respectively. Contract for the fabrication of the service bridges was entered into with the Des Moines Bridge & Iron Co. The erection of the rollers and foot bridges by Government forces was commenced in March and completed on June 26, 1915.

MAIN CANAL, DIVISION NO. 1.

This division of the main canal extends from the diversion dam through the Grand River Canyon to the lower portal of Tunnel No. 3. Its function is to conduct a maximum of 1,425 second-feet of water to the site of the proposed power plant at the upper portal of Tunnel No. 3 and thence conduct 670 second-feet of irrigation water to the lower end of Tunnel No. 3. Of the total length of 6 miles, 3.6 miles are open canal and 2.4 miles in tunnel. The three tunnels are, respectively, 3,723, 1,655, and 7,292 feet in length. The principal structures are three reinforced concrete siphons to carry the canal under three watercourses which are subject to torrential floods; a combined wasteway and railroad bridge; and one double 4½ by 5 foot concrete culvert.

Tunnel No. 1.—This tunnel is 3,723 feet long, of horseshoe-shaped section, with a height of 14 feet, a maximum width of 17 feet 6 inches, and a carrying capacity of 1,425 second-feet. The construction of

Tunnel No. 1 by Government forces was approved by the department on October 5, 1912. The erection of a camp near the south portal was begun on October 8, 1912, and the excavation of this portal cut on October 22. On November 14 work was started on the excavation of the tunnel proper in the south heading and on January 5, 1913, in the north heading. The work was prosecuted with two shifts per day until the tunnel was holed through on September 27, 1913. The material excavated was mostly a hard, blocky shale with a mixture of sand and bowlders for a considerable distance near each portal. Ventilation was secured through three shafts and one adit driven from the tunnel to the surface at convenient points. The construction plant consisted of three boilers of 80 horsepower each, a 150-horsepower steam engine driving a 100-kilowatt 250-volt direct-current generator, and one steam-driven air compressor with a capacity of 600 cubic feet. The excavation of the tunnel was carried on by hand until February, 1913, when the power plant was put in operation. After this date all drilling was performed by compressed-air drills and the tramming by electric locomotives.

A plant for crushing and screening sand and gravel and mixing concrete for lining the tunnel was completed in October, 1913, and the first concrete was placed in November. Two shifts per day were used in this work until February, 1914, when a third shift was added and the work was thereafter carried on with three shifts per day until its completion on March 25, 1914.

Tunnel No. 2.—This tunnel is 1,655 feet in length, 14 feet high, and 16 feet wide. The larger portion of the tunnel is of horseshoe shape, but several hundred feet are of square section with arched roof and for a short distance, where satisfactory sandstone formation was encountered, the arching was omitted entirely.

Authority for the construction of Tunnel No. 2 by Government forces was granted by the department on March 1, 1913. The excavation of the upper portal was begun on March 4, 1913, and the excavation of the tunnel section on March 18. Drilling was done by hand until May 24, when a compressed-air line from the power plant at Tunnel No. 1 was completed and power drills were put in operation. The excavation was continued from the upper portal until the end of October, 1913, when it was discontinued, at a distance of 1,000 feet in from the portal to allow the grading contractor to finish up the adjacent waste banks. At the lower portal the excavation of the portal cut was begun in July and of the tunnel proper on August 5, 1913. The tunnel was holed through December 27, 1913, and the excavation fully completed January 12, 1914.

The concreting of Tunnel No. 2 was carried on from the plant erected also for the lining of Tunnel No. 3. The first concrete was placed on September 4, 1914, and the work was completed on November 28.

Tunnel No. 3.—This tunnel is 7,292 feet in length, with horseshoe section 11 feet high by 11 feet 6 inches wide and lined with concrete throughout. It has a carrying capacity of 670 second-feet with a water depth of 9 feet. The construction of Tunnel No. 3 by Government forces was authorized by the department on September 23, 1913.

The excavation of an adit opposite the middle of the tunnel was commenced on October 20, 1913, and the excavation of the upper and lower portal cuts was started soon afterwards. The excavation of the tunnel was prosecuted in four headings with two shifts per day, and later with three shifts per day, in each heading. Headings 1 and 2 were holed through on September 25, 1914. The material encountered in these headings consisted of an unstable formation of earth and sandstone bowlders. Headings 3 and 4 were holed through November 18, 1914. The material encountered in these headings consisted principally of a hard, gritty shale. The excavation of all headings was started by handwork, but air drills and electric power for tramming were made available on February 5, 1914. All power used in the construction of this tunnel was generated at the central power plant at Cameo, transmitted at 2,300 volts alternating current to a substation at the adit, where it was converted to 250 volts direct current, in which form it was used on the work. Compressed air for operating the drills was conducted from the compressor in the central power plant through 4 and 3 inch air lines to each of the four headings. With the exception of a small building for office headquarters and one bunk house no camp was erected for housing the men employed on the excavation of this tunnel, on account of the short distance to the town of Palisade.

In August, 1914, the installation of a camp and concrete plant for use in concreting Tunnels Nos. 2 and 3 was completed. This camp was located near the upper portal of Tunnel No. 3. The concreting of this tunnel was started on October 7, 1914, and completed on February 24, 1915. Three shifts per day were used during the greater part of the work. The concreting plant consisted of a combined crushing, screening, and mixing plant, including one No. 4 gyratory crusher with bucket elevator and revolving screen and one 30-cubic-foot mixer. Sand and gravel were secured from gravel beds on the opposite side of the Grand River, loaded into cars, and hauled across on a temporary pile bridge constructed for this purpose. All tramming was performed by electric locomotives. Wooden forms were used throughout and the concrete in the sides and arch of the tunnel was placed from a traveler.

Earthwork and structures.—Proposals for the earthwork in the canyon division, under specifications No. 239, were opened on June 2, 1913, and contract awarded to the Reynolds-Ely Construction Co. Work was started by the contractor on July 9, 1913, and was completed in July, 1914. This contract involved the excavation of about 360,000 cubic yards of earth and rock and 1,500,000 station yards of overhaul. One steam shovel and several team outfits were used on the work. The contractor also loaded 16,000 cubic yards of material into standard-gauge dump cars for use in raising the grade of the railroad track in the vicinity of the diversion dam. These cars were handled by the forces of the Rio Grande Junction Railway Co., who also performed the track-raising work. A total of 5,800 feet of track was raised to a maximum height of 5 feet.

A double 4½ by 5 foot concrete culvert at station 237+565 and three reinforced concrete siphons under Asbury, Jerry, and Coal Creeks were constructed by Government forces during the seasons of 1913 and 1914. A plate girder bridge, with concrete piers and abutments, to carry the tracks of the Rio Grande Junction Railway over the main canal at station 23 was completed in October, 1914, and the sluiceway adjacent to this structure was completed in June, 1915.

MAIN CANAL, DIVISIONS 2, 3, AND 4.

These three divisions cover all that portion of the main canal below Tunnel No. 3, consisting of a total length of 56 miles. Division No. 2 extends from station 317 to station 911+50 and covers the section through the Mesa County irrigation district, division No. 3 extends from station 911+50 to station 1,660, and division No. 4 extends from station 1,660 to the terminus.

Advertisement for the earthwork on the first 30 miles of canal was issued April 27, 1914, under specifications 269, and contract was awarded to the low bidders, the Winston Bros. Co., of Minneapolis, at a flat price of $0.1975 per yard. Work was started by the contractors on July 16, 1914, and prosecuted vigorously until the completion of the contract on July 15, 1915. The larger portion of the excavation was performed by power machinery. Two steam and two kerosene drag-line excavators and one steam shovel were used on the work. All banks were constructed by teams up to the maximum water level in the canal and the remaining excavation was taken out with the drag-line excavators. The total yardage involved in this contract was 1,900,000. The material consisted of earth and shale.

Bids for the next 10 miles of the main canal were opened on March 10, 1915 (specifications 297), and contracts were awarded to the Reynolds-Ely Construction Co. and the Mendenhall, Straw & Bird Co. Work was started on April 1 and completed on September 20, 1915.

LATERAL SYSTEM.

The policy adopted in the location of the lateral system provided for the delivery of water to each farm unit of Government land and to each private holding of patented land as subscribed to the water users' association. The excavation of all laterals was performed by contract and the structures were erected by Government forces. Bids for the earthwork on 65 miles of laterals in the first lateral district were opened on March 4, 1915, and contract was awarded to the Mendenhall, Straw & Bird Co. This work was completed by the contractors on September 8, 1915. The construction of structures by Government forces was started late in 1914 and prosecuted from two camps.

TELEPHONE SYSTEM.

The project telephone system consists of a line 53 miles in length, paralleling the main canal from the headworks to the Uintah Railroad, with a branch 2 miles in length connecting with the line of the Mountain States Telephone & Telegraph Co. Exchange service is furnished under contract with this company. The project line consists of a full metallic circuit of No. 12. B. B. galvanized iron wire strung on 25-foot cedar poles. The first 6 miles of line were built in 1913 and 1914 in connection with the construction work on the canyon division, a portion of this line being used to carry electric transmission wires to the various construction camps. The next 39 miles were erected in the fall of 1914 and the last 10 miles were completed in June, 1916. With the exception of about 1 mile built under contract all work was performed by Government forces.

CONSTRUCTION DURING FISCAL YEAR.

Grand River Dam.—The erection of the roller crests and service bridges was completed late in June, 1915, and the remaining concrete in the walls of the hoist houses and power house was then placed. The embankment of the Rio Grande Junction Railway was protected by riprapping for a distance of 1,200 feet upstream from the dam. The spring floods were less than normal, the river reaching a maximum discharge of only 21,000 second-feet, and falling rapidly enough to permit the unwatering of the channel below the sluiceway by July 20. The protective work in the sluiceway channel, consisting of 100 linear feet of heavy rubble-masonry wall, 125 linear feet of grouted paving, and heavy riprap in the bottom of the channel, was completed in September.

The construction of the upstream wing wall for the protection of the east abutment and the raising and protection by riprapping of the outer bank of the Orchard Mesa Canal upstream from the dam was undertaken late in October and completed in December, 1915. This completed the concrete work in the dam, and the concrete plant and substation were dismantled, all equipment was transported across the river and stored near the railroad siding, and the construction force disbanded.

Advertisement for the chains and shafts for the hoists to operate the rollers was issued July 12, 1915. The one bid received was rejected; readvertisement was issued on September 25, and contract entered into with the Lakeside Bridge & Steel Co. for the manufacture and delivery of this machinery before February 20, 1916. Advertisement was also issued and contracts let for the permanent power-plant equipment, consisting of gasoline-electric generating set, motors for operating the head gates and roller crest hoists, and storage batteries. Delivery of the chains and chain shafts was delayed far beyond the time limit, and no shipment of this machinery had been received at the close of the fiscal year.

On account of the delay in delivery of the chains and shafts, emergency equipment was purchased to operate the sluiceway roller, in order to permit the diversion of water into the main canal for the irrigation of project lands and continuing the seasoning and priming of the canal. The six 70-foot rollers were raised prior to the high-water period by means of a chain and shaft which had previously been purchased for temporary use. On June 30, 1916, nearly all the power-plant equipment had been delivered and installed. The construction of the dam was practically complete, except for the installation of such machinery as had not yet been delivered, the disposition of construction equipment, and the dismantling of camp buildings.

Main canal, divisions 1, 2, and 3.—The construction of these three divisions was practically finished on July 15, 1915, on which date the Winston Bros. Co. completed their contract for the excavation of 30 miles of the main canal. The structures on this portion of the canal had meantime been completed by Government forces. Water was turned into the main canal in June, 1915, and the work of seasoning and priming was carried on during the fall of 1915 and spring of 1916.

Main canal, division 4.—Contracts for the excavation of 10 miles of the main canal between stations 1933 and 2437 (specifications 297) were completed in September, 1915, and for the excavation of the following 9 miles (specifications 320) in June, 1916. The following structures on this division were completed by Government forces: Three main canal flumes, 5 overshot flumes, 3 highway bridges, 8 inlet structures, 4 vitrified-pipe culverts, and 3 corrugated-iron culverts. Bids were opened on May 23, 1916 (specifications 335), for furnishing and erecting a 60-inch wood stave pipe siphon 3,950 feet in length across East Salt Creek Valley, and contract entered into with the successful bidder on June 22. Work was in progress at the end of the fiscal year by Government forces on grading for the foundations of this pipe and on the erection of a trestle at East Salt Creek. In June, 1916, a 10-mile extension of the project telephone line to the main canal crossing of the Uintah Railway was completed.

Lateral system.—In the first lateral district contract for the excavation of 65 miles of laterals (specifications 297) was completed on September 8, 1915. Bids were opened on July 1, 1915, for 20 miles of laterals in the second district, and contracts executed with seven small contractors, this work having been advertised in small schedules with the restriction that only one schedule would be awarded to a bidder. The last of these contracts was completed in March, 1916. Bids for the excavation of an additional 35 miles of laterals in this district were opened on November 4, 1915 (specifications 320), and contracts for this work were awarded to eight small contractors, one of whom failed to qualify. All except four of these contracts were completed on June 30, 1916, and work is now in progress on those remaining.

The construction of lateral structures was continued throughout the year by Government forces. The following structures were completed: Nine lateral head gates, 479 drops, 543 turnouts, and 207 miscellaneous minor structures. The priming and puddling of the laterals and structures in the first lateral district were carried on during the fall of 1915 and spring of 1916. On June 30, 1916, the lateral system in the first district was 96 per cent complete, and laterals for supplying 10,000 acres in the second district were 85 per cent complete. Location surveys are in progress in the third lateral district, and advertisement for the earthwork will be issued at an early date.

SEEPAGE AND DRAINAGE.

Soon after water was turned into the main canal in June, 1915, considerable leakage developed through the shale cuts, affecting a small area of the improved lands in the Mesa County irrigation district, as well as some of the unimproved project lands. Steps were taken at once to relieve this situation by plowing, harrowing, and rolling the bottom of the canal, and covering the exposed shale on the slopes with fine material. This work was continued during the winter of 1915–16 and spring of 1916. All shale cuts on divisions 2 and 3 were treated in this manner and, in addition, a considerable amount of material was scraped into the canal for silting purposes. With the operation of the canal during the season of 1916 a marked improvement in seepage conditions was apparent. Several tracts in the Mesa County district which were seeped in 1915 are now entirely dry. A survey of the seeped area in June, 1916, showed a total of 275 acres of project lands affected. Preparation is being made for the installation of a silting plant to further reduce the leakage from the main canal.

Investigations in Grand Valley Drainage District.—Contract with the Grand Valley Drainage District providing for the preparation by the Reclamation Service of designs and estimate of a drainage system for the district and the repayment by the district of the cost of this work was entered into by the Secretary under date of December 13, 1915. Field work was started in March, 1916, and prosecuted vigorously during the balance of the fiscal year. On June 30, 1916, practically the entire district had been covered by borings and test wells at frequent intervals, and profiles of the ground-water level had been prepared. The investigations indicate that a large percentage of the land in the district is seriously waterlogged and in immediate need of drainage.

ECONOMIES OF GOVERNMENT WORK.

The larger and more hazardous features of this project, such as the Grand River Dam, tunnels, siphons, and flumes, were constructed by Government forces without previous advertisement, for the reason that the service already owned the necessary construction plant, which was available for transfer from near-by projects.' The risks involved in this class of work are large and can be carried by the Government at a lower cost than by contractors, who must bid high enough to provide for all contingencies. While no definite statement can be made of the total savings effected by the performance of this work by Government forces, it is believed that the unit costs of the completed work compare favorably with the costs of similar work performed by contract, and that on many of the features material savings resulted.

One specific saving which may be cited was effected in handling 20,000 cubic yards of gravel for the lining of tunnels No. 2 and No. 3. The lowest bid received for loading and hauling this gravel was 42½ cents per cubic yard. This bid was rejected and the work performed by Government forces at a cost of 33 cents, a saving of 9½ cents per yard, which represents a total saving to the project of $1,900.

OPERATION AND MAINTENANCE.

Water was first turned into the main canal in June, 1915, and during the remainder of the season a small flow was maintained for the purpose of seasoning and priming the first 37 miles of the main canal and the laterals in the first lateral district. No attempt was made to maintain a continuous flow, but water was furnished incidentally to all landowners desiring to make use of it. About 400 acres were irrigated during the fall of 1915. Beginning with the season of 1916 the regular operation of the project was commenced, water being available for 14,500 acres of land in the first lateral district. All water is furnished on a rental basis at the rate of 40 cents per acre-foot. On June 30, 1916, water-rental applications for 2,757 acre-feet of water had been made, covering approximately 2,576 acres of land.

SETTLEMENT.

No public notices have been issued for this project and no Government lands are open to entry. A few transfers of private lands have been effected, but few new settlers have been secured, and the settlement of the project as a whole is progressing very slowly.

PRINCIPAL CROPS.

No crops were matured on the project during the season of 1915. The principal growing crops in the season of 1916 are wheat, oats, sugar beets, alfalfa, and fruit, the latter consisting of orchards formerly irrigated by pumping from private canals. The crop outlook on older cultivated lands is good, but crops on the new lands are in only fair condition, due to unfavorable weather conditions during the fore part of the season and to lack of humus in the soil of the raw lands.

FINANCIAL STATEMENT.

(Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 700.)

Feature costs of Grand Valley project to June 30, 1916.

Feature.	Subfeature.	Principal feature.
Examination and surveys		$69,745.12
Canal system:		
Preliminary and general work	$293,897.81	
Diversion dam and headworks	498,570.86	
Tunnels	704,786.53	
Main canals	723,777.04	
Flumes	68,169.33	
Bridges	33,652.59	
Siphons	67,692.35	
Wasteways	26,600.74	
Culverts and drains	75,478.00	
		2,492,625.25
Lateral system:		
Preliminary and general work	15,771.49	
Headworks	2,562.03	
Laterals and sublaterals	180,831.81	
Flumes	154.81	
Siphons	2,172.96	
		201,493.10
Drainage system:		
Preliminary and general work (project)	2,153.46	
Open drains	164.57	
Preliminary and general work (Grand Valley drainage district)	10,853.33	
		13,171.36
Flood protection: Preliminary and general work		635.54
Farm units: Preliminary and general work		3,530.82
Permanent improvements and land:		
Buildings	685.07	
Roads	5,502.28	
Bridges	6,205.23	
		12,392.58
Telephone system: Telephone lines		11,818.16
Operation and maintenance during construction		4,650.40
Plant accounts		14,476.90
Gross cost of construction of project to June 30, 1916		2,824,539.23
Less revenues earned during construction period:		
Rental of buildings	1,327.86	
Rental of grazing and farming lands	1,471.74	
Rentals, power, and light	259.92	
Rentals of irrigation water	1,187.80	
Rentals of telephones and tolls	15.65	
Forfeitures by defaulting bidders and contractors	230.00	
Other revenues, unclassified	4.50	
Profit on mess-house operations	10,667.23	
Profit on mercantile-store operations	1,208.05	
Profit on hospital operations	3,196.74	
		19,569.49
Net cost of construction of project to June 30, 1916		2,804,969.74

Estimated cost of contemplated work, Grand Valley project, during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examination and surveys: Preliminary and general work		$4,400
Pumping for irrigation: Preliminary and general work		5,000
Canal system:		
Preliminary and general work	$14,900	
Diversion dam and headworks	15,000	
Main canals	16,250	
Flumes	10,500	
Bridges	2,560	
Siphons	32,310	
Wasteways	4,590	
Culverts and drains	3,890	100,000
Lateral system:		
Preliminary and general work	8,000	
Headworks	3,690	
Laterals and sublaterals	81,235	
Flumes	1,190	
Siphons	51,000	144,175
Drainage system:		
Preliminary and general work	40,000	
Open drains	30,000	
Closed drains	15,000	
Bridges	5,000	90,000
Flood protection:		
Preliminary and general work	2,000	
Levees and dikes	13,000	15,000
Farm units: Preliminary and general work		6,000
Permanent improvements and land:		
Buildings	2,000	
Roads	500	
Bridges	500	3,000
Telephone system: Telephone lines		1,000
Operation and maintenance during construction (water rental)		45,500
Messes		1,000
Hospitals		1,000
Total		416,075

COLORADO, UNCOMPAHGRE VALLEY PROJECT.

F. D. Pyle, project manager, Montrose, Colo.

LOCATION.

Counties: Montrose and Delta.

Townships: 15 S., Rs. 94 to 96 W., sixth principal meridian; 48 to 51 N., Rs. 7 to 12 W., New Mexico meridian.

Railroad: Denver & Rio Grande.

Railroad stations and estimated population January 1, 1916: Montrose, 3,400; Olathe, 600; and Delta, 2,500.

WATER SUPPLY.

Sources of water supply: Gunnison and Uncompahgre Rivers.

Area of drainage basins: Gunnison River, 3,850 square miles; Uncompahgre River, 500 square miles.

Run-off in acre-feet: April to November, inclusive, Gunnison River at River Portal (3,850 square miles), 1905 to 1915: Maximum, 1,798,000; minimum, 875,000; mean, 1,398,000. Uncompahgre River at Fort Crawford (500 square miles), 1896–1899, 1903–1905, 1908–1915: Maximum, 256,700; minimum, 124,000; mean, 169,900.

LANDS OPENED FOR IRRIGATION.

One hundred and sixty-eight farm units were opened to entry on September 1, 1915. All lands irrigated from canals operated by the Reclamation Service are furnished water under rental contracts. All unentered units were again withdrawn from entry on October 8, 1915.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916: Estimated at 85,000 acres.

Area under rental contracts, season of 1916: Estimated at 85,000 acres.

Area irrigated, season of 1915: 41,463 acres.

Length of irrigating season: From April 1 to October 31, 214 days, on all Government canals except the Loutsenhizer, under which the season ends November 15.

Average elevation of irrigable area: 5,500 feet above sea level.

Rainfall on irrigable area: 16 years, average 9.33 inches; 1915, at Montrose, 8.98 inches.

Range of temperature on irrigable area: —25° to 98° F.

Character of soil of irrigable area: Red sandy gravel, adobe, and clay loam.

Principal products: Alfalfa, grain, fruits, sugar beets, potatoes, and vegetables.

Principal markets: Denver, Colo.; Chicago, Ill.; and local mining camps.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys begun in June, 1901.
Construction recommended by director March 7, 1903.
Construction conditionally authorized by Secretary, March 14, 1903.
Construction authorized by Secretary, June 7, 1904.
Contract for construction of Gunnison Tunnel approved October 18, 1904.
First irrigation by Reclamation Service, season of 1908.
Gunnison Tunnel completed for present use June, 1910.
Gunnison River diversion dam completed January, 1912.
Entire project 69.3 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Uncompahgre Valley project provides for the diversion of water from the canyon of Gunnison River by means of a tunnel about 6 miles long and a canal 11 miles long to supplement the flow of Uncompahgre River, and in addition thereto the utilization of all waste, seepage, spring, percolating, and return water arising within the project in the irrigation of lands in Uncompahgre Valley. To distribute the waters of the Uncompahgre and Gunnison Rivers thus combined the plan provides for the purchase, enlargement, and extension of the more important private canals taking water from Uncompahgre River and for supplementing them by laterals diverting from the South Canal and by high-line canals, one on either side of the valley, taking water from Uncompahgre River.

The surveys for and diamond-drilling investigation of the Taylor Park Reservoir have been completed, but no construction work has been undertaken. The diversion dam in the Gunnison River is completed. The Gunnison tunnel is completed to the extent necessary for its present use; there remains about 45 per cent of the length of the tunnel to be lined with concrete. The South, West, Montrose & Delta, Selig, East, and Garnet Canal systems are completed, except for the installation of measuring and other minor structures, and the excavation, enlargement, and extension of a few small laterals. The Loutsenhizer Canal system is completed, except for the building of one small lateral, the installation of measuring devices and other minor structures, and the purchase of outstanding Loutsenhizer water rights. The excavation of and building of structures on the main line of the Ironstone Canal system have been completed, and considerable progress has been made in building the lateral system and in purchasing outstanding shares of the old Ironstone and Ironstone extension ditches.

SUMMARY OF GENERAL DATA FOR UNCOMPAHGRE PROJECT TO JUNE 30, 1916.

Areas:			
Irrigable acreage when project is complete			140,000
Public land entered June 30, 1916			25,578
Public land withdrawn June 30, 1916			12,674
Private land June 30, 1916			101,748
Acreage service could have supplied season of 1915			62,147
Addition in fiscal year 1916			22,853
Estimated addition in fiscal year 1917			10,000
Estimated acreage service can supply July 1, 1917			95,000
Acreage actually irrigated season of 1915			41,463
Acreage cropped under irrigation season of 1915			40,553
Crops:			
Value of irrigated crops, season of 1915			$1,044,915
Value of irrigated crops per acre cropped			$25.76
Finances:			
Estimated cost of completed project			$9,409,000
Total construction cost to June 30, 1916			$6,479,051.43
Per cent complete June 30, 1916			69.3
Appropriation for fiscal year 1917, total			$288,000
Allotment for construction fiscal year 1917			$297,400
Estimated per cent complete June 30, 1917			72
Announced construction charges per acre			(1)
Appropriation, fiscal year 1916			$469,000.00
Expenditures during fiscal year chargeable to 1916 appropriation:			
Disbursements	$345,081.89		
Transfers	19,652.73		
		$364,734.62	
Registered liabilities chargeable to 1916 appropriation		38,700.67	
Contract obligations wholly covered by 1916 appropriation		768.30	
			$404,203.59
Unencumbered balance, July 1, 1916			$64,796.41

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[1] No public notice issued.

Repayments:	
Water rental charges—	
Accrued to June 30, 1916	$369, 741. 51
Collected to June 30, 1916	$369, 741. 51
Drainage:	
Estimated acreage damaged by seepage to June 30, 1916	15, 000
Cost of drainage works to June 30, 1916 (surveys)	$2, 792. 35

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

TUNNEL ROAD AND TELEPHONE LINE.

Work on the final location of the tunnel and of a wagon road to River Portal was begun promptly after the authorization of the project. The construction of the wagon road, a necessary preliminary to work at River Portal, was commenced in July and completed in October, 1904, by Government forces.

A telephone line was constructed by contract in November and December, 1904. The line, which is 24.42 miles long, extends from Montrose to the west portal of the tunnel, thence to Cedar Creek station and River Portal. A branch from this line extends along the south canal to Uncompahgre River.

GUNNISON TUNNEL.

The western end of Gunnison Tunnel is located on the Marshall Pass line of the Denver & Rio Grande Railroad, and the eastern end is located in the canyon of Gunnison River and is reached by a wagon road. The tunnel takes water from Gunnison River, the bottom of the intake being about 7 feet below the low-water line, and delivers it in Uncompahgre Valley.

The tunnel is 30,645 feet in length and has a uniform grade of 2.02 in 1,000, the upper end being 6,433 and the lower end 6,371 feet above sea level; the bottom is flat and 10 feet in width; the straight sides are 10 feet high and batter outward toward the top 6 inches in 10 feet, and the roof is arched with a span of 11 feet and a rise of 2½ feet within the cement lining. The entire area of the cross section inside the masonry is 122 square feet, the water-carrying cross section is estimated at 100 square feet, and the flow of water that can be delivered through the tunnel is estimated at 1,200 second-feet.

Proposals for the construction of the Gunnison Tunnel were opened October 5, 1904, and a contract for the work was executed on November 21, 1904. The contract provided for the excavation and lining of 30,582 feet of tunnel and of a cut at the west portal 1,950 feet long, with a maximum depth of excavation of 49 feet. Excavation was begun on January 11, 1905.

About the middle of May, 1905, 15 per cent of the contract time had elapsed and less than 4.5 per cent of the work had been accomplished. Neither the organization developed nor the mechanical plant installed were adequate for the work, and the contractors were in financial difficulties. The contract was therefore suspended, and on May 27, 1905, the Reclamation Service undertook the continuation of the tunnel.

Working facilities were bettered as fast as circumstances would permit. Equipment and tools urgently needed were purchased, and the organization was improved and increased. Proposals for the completion of the work were invited, to be opened on September 26, 1905, and pending the opening of proposals very little change was made in the methods of tunnel excavation. The three proposals opened on September 26 were rejected and the decision made to complete the tunnel by forces working under the direct supervision of the engineers of the Reclamation Service.

Gunnison Tunnel was driven at four headings, as follows: Heading No. 1, driven westward from the east portal for a distance of 10,879 feet; heading No. 2 driven eastward from the main shaft for a distance of 14,824 feet; heading No. 3 driven westward from the main shaft for a distance of 1,696 feet, and heading No. 4 driven eastward from the west portal for a distance of 3,246 feet. The main shaft is located 4,942 feet from the west portal, and headings 3 and 4 were driven to the meeting point on July 4, 1906, about 14 months after the work was taken over by the service. During this interval heading No. 2 had been driven eastward from the main shaft nearly 1 mile. Headings 1 and 2 were connected on July 6, 1909.

The water and ventilating pipes were then removed and the work of enlargement to full section was begun. The enlargement, trimming, and cleaning of the tunnel was completed in March, 1910. By June 30, 1910, the concrete lining for all timbered sections and all rock sections where rapid disintegration would be likely to occur had been completed.

GUNNISON RIVER WEIR.

In order to maintain a full flow in the Gunnison Tunnel during the low stages of the Gunnison River, it was necessary to construct a diversion weir at the mouth of the tunnel. Diamond drilling investigations during the year 1905 showed no bedrock, and as a result a rock fill crib-type dam structure was adopted. The weir is divided into bays, 6 feet square, with a crest 18 feet wide and 240 feet long and an apron 42 feet wide and 6 feet below the crest. The bottom of the weir is 4 feet below the river bed and top of the deck one-half foot below the top of the tunnel gates. Concrete cut-off walls were built at both ends of the weir and a concrete fishway was provided at the west end of the structure. On the east side of the river the weir is anchored to the rock cliff and on the west side to the sluiceway walls. The sluiceway is a concrete structure adjoining the intake to the Gunnison Tunnel and is contracted by two 6 by 8 foot cast-iron gates operated by a geared hand hoist. Construction work was commenced during December, 1910, and continued until May, 1911. Work was resumed during August, 1911, and completed during January, 1912. The construction of the weir involved the excavation of 10,500 cubic yards and the placing of 1,500 cubic yards of concrete and 1,700 cubic yards of rock fill and 552,000 feet b. m. of timber. One hundred and fifty cubic yards of grouted paving were placed on the earth slopes above the sluiceway and 175 cubic yards of rock fill dumped into depressions in the river bed above the weir during the summer of 1912. The collapsible steel flashboards for maintaining the head in the Gunnison Tunnel were installed during the summer of 1915. The top of the flashboards when in a vertical position is 4 feet 3 inches above the top of the weir.

Each flashboard is 3 feet wide, and a total number of 80 were required across the crest of the weir.

SOUTH CANAL SYSTEM.

The South Canal has a capacity of 1,300 second-feet, is 11½ miles in length, and extends from the west portal of Gunnison Tunnel to the Uncompahgre River, about 9 miles southeast of Montrose, Colo. Its main purpose is the conveyance of water from Gunnison River to Uncompahgre River for distribution through other canals diverting from that river. A small amount of water, however, is distributed directly from several diversion head gates along the South Canal.

The west portal cut of Gunnison Tunnel is 2,050 feet in length and lined with concrete. From the portal cut to the Uncompahgre River the South Canal main line consists of 35,943 feet of earth canal, 19,394 feet of concrete-lined canal, five tunnels 2,663 feet in aggregate length, and a wooden flume 336 feet in length.

Proposals for the earthwork of approximately 4 miles of canal comprising divisions 1 to 9 were opened on September 15, 1904, and three contracts for the work were executed October 18. The work under these contracts was completed, respectively, in April, June, and September, 1905. On August 28, 1905, proposals were opened for the work on divisions 10 to 21, inclusive, of the South Canal. A contract for the entire 12 divisions was executed on September 30, 1905. The contractors began work in October, 1905, and completed the contract in October, 1907. Proposals for the construction of division 22 were opened June 1, 1907, and a contract for the work was executed on June 3. This contract was completed in May, 1908. Miscellaneous construction work on the canal was done under contract and some minor parts of the work were executed by Government forces.

A concrete spillway and wasteway was built at the end of the portal cut to throw the entire flow of the Gunnison Tunnel into Cedar Creek in case of a break along the main line of the South Canal. The permanent structures on division 18 of the main line of the South Canal were completed during 1914 and 1915; these works consisted of the replacing of the 336-foot temporary flume with a timber flume, full capacity, 409 feet long, and the building of a connecting concrete channel 288 feet long between the flume and Tunnel No. 5. A number of laterals were built from the main line. All work on the lateral system was accomplished by Government forces except for the excavation of a small lateral 2.22 miles long, which was accomplished under an informal contract dated December 16, 1912. The Cedar Valley system has a maximum capacity of 50 second-feet, and consists of three laterals having a total length of 14.32 miles. Lateral No. 2 has a length of 4.08 miles and a maximum capacity of 30 second-feet. The High Line system consists of 13.99 miles of main line and 9.94 miles of laterals, the maximum capacity of which is 50 second-feet. The main line and one of the laterals of this system were private canals, transferred to the United States. The High Line canal diverts directly from the Uncompahgre River. A feeder ditch from the South Canal serves as an auxiliary supply to the system. The construction of all laterals under the South

Canal system necessitated the building of a large number of minor structures.

WEST CANAL SYSTEM.

The West Canal has a maximum capacity of 120 second-feet, and will irrigate 7,200 acres above the Montrose and Delta Canal system on the west side of the Uncompahgre River. This system consists of 12.38 miles of main line and 22.86 miles of laterals. The excavation of the main line between station 15 and station 605 was accomplished under contract and involved the removal of 188,410 cubic yards and the driving of 1,750 feet of tunnel. The excavation between station 4 and station 15 and between station 605 and station 649 amounted to 24,068 cubic yards, and was removed by Government forces. The main line diverts directly from the South Canal, the flow being flumed over the Uncompahgre River. An auxiliary supply can be obtained from the Uncompahgre River through a feeder ditch, which was excavated under an informal contract entered into under date of November 6, 1915. The headworks flume structure has a total length of 760 feet; the river crossing is made on four plate girder spans, supported on concrete piers 70 feet center to center, the balance of the flume being supported on the ordinary flume trestle. The furnishing and erecting of the plate girder spans was accomplished under an informal contract dated February 20, 1915. All other work along the main line was accomplished by Government forces and consisted of the following: The building of a concrete-lined channel crossing for the railroad and county highway; the excavation of a tunnel road; the straightening of channels for Horsefly and Happy Canyon Creeks; the building of a concrete overdrain; the building of a timber headworks and wasteway for the feeder ditch; the lining of the tunnel with concrete; the building of 42-inch to 24-inch diameter concrete and corrugated iron pipe culverts for drainage purposes; the building of bridges and crossover flumes; the building of eight semicircular steel flumes of the Hess type, varying in size from No. 204 to No. 168, and having a total length of 1,492 feet; and the building of one concrete and two timber wasteways. Numerous turnouts, measuring devices, and other minor structures were also installed.

The Shavano lateral has a total length of 8.94 miles and was excavated under five informal contracts entered into during December, 1912, involving the removal of 34,703 cubic yards of material. A small tail ditch was excavated by Government forces. All structures along the lateral were built by Government forces and consisted of the following: The building of six flumes, having a total length of 346 feet, five of which were of the semicircular steel type, varying in size from No. 84 to No. 60, and one of wood; and the building of one pipe culvert, two concrete ditch culverts and overdrains, and one concrete siphon. Numerous minor structures, such as bridges, drops, measuring devices, etc., were also built.

The West Canal extension has a total length of 6.73 miles. All work on this lateral was accomplished by Government forces except for the driving of 800 linear feet of tunnel and the excavation of 7,544 cubic yards of tunnel approaches, which were accomplished under a formal contract dated January 29, 1913. The excavation of the lateral involved the removal of 27,093 cubic yards. The tunnel was lined with concrete, and numerous minor structures were built on the lateral.

The West Canal extension lateral, 1.98 miles long and involving the removal of 4,523 cubic yards, was excavated under an informal contract dated September 24, 1913.

MONTROSE AND DELTA CANAL.

The Montrose and Delta Canal diverts water from Uncompahgre River 2 miles below the South Canal outlet, crosses the bottom lands, follows the bluff on the west, crosses Spring Creek Mesa, and discharges into Coal Creek. The natural channel of Coal Creek is used for about 5 miles. A timber dam then diverts the water into an extension of the canal which follows the foot of the small mesas. The total length of main line is 31½ miles, and the system includes six laterals aggregating 46½ miles in length.

The construction of the Montrose and Delta Canal was begun in 1883 and completed to Coal Creek in 1884. The extension was constructed in 1885 and 1886. The system was acquired by the United States through purchase from the Montrose and Delta Canal Co. in May, 1908. The principal structures, which are all of timber, are the intake, the flumes over Horsefly, Dolores, Happy Canyon, Spring, and Dry Creeks, and the head gates for supplying the laterals.

During the winters of 1908–9 and 1909–10, the first 15 miles of canal were enlarged to practically double the original capacity, 107,730 cubic yards of material being removed. The old timber headworks were torn out. A dike 1,500 feet long was built to confine the river to a fixed channel. The dike was joined on one end to a sheet-piling wing wall leading from the control weir. The control weir is a timber structure, supported on a pile foundation, the river being regulated by 15 collapsible flashboard frames, which are raised and lowered from an operating bridge. The river intake is a concrete structure controlled by eight 4 by 6 foot cast-iron gates operated with hand-wheel hoists. A concrete retaining wall on the right side of the channel joins the river intake with the concrete canal intake and sluiceway. The canal intake is controlled by eight 4 by 4 foot and the sluiceway by six 4 by 6 foot cast-iron gates operated with handwheel hoists. A concrete retaining wall was built below the canal intake and concrete retaining walls were built for the main highway crossing. Considerable excavating work was accomplished in maintaining the canal on the sidehill location between Happy Canyon and Ducketts Basin. The old timber flume over Happy Canyon Creek was replaced with a No. 204 twin semicircular flume with concrete approaches.

A four-room section house and outbuildings were constructed in Coal Creek Valley. An A-shape timber dam was built across Coal Creek to divert water into the extension of the main line, the sluiceway is controlled by two 4 by 5 foot cast-iron gates operated by geared hoists, and the extension intake by three 3.5 by 4 foot wooden gates operated by handwheel hoists. Coal Creek is held in a fixed channel at this location by a small dike 550 feet long. A combination timber flume and culvert under the extension canal was built at Big Sandy to pass the flood waters of that drainage basin under the canal. A drain channel leading from this structure to Dry Creek was also built.

The Spring lateral, having a maximum capacity of 20 second-feet, diverts direct from Spring Creek and is 5.43 miles long; several minor structures were built on this lateral.

The Franklin and High Mesa laterals having a capacity of 70 second-feet and length of 8.35 miles, were built to supply Franklin and High Mesas. The principal feature of these laterals consists of a 26-inch inverted steel ingot iron pipe siphon 3,808 feet long; numerous drops, bench flumes, and other minor structures were built on the laterals.

The King Lateral and King Lateral Extension Canals are the high-line canals on the west side of Coal Creek; the maximum capacity at the headworks being 125 second-feet, and length 21.37 miles. The headworks are located at the bottom of the "Big Drop" on the main line of this system and consist of a masonry wall sunk across the channel to which was attached the framework for a wooden weir, the sluiceway and intake being located at one end. Two siphons were built on the King Lateral Extension, one of concrete 50 feet long and the other of 36-inch riveted steel pipe 1,416 feet long across Dry Creek. The construction of these canals required the building of 24 semi-circular Maginnis steel flumes, having a total length of 4,408 linear feet and varying in size from No. 120 to No. 60. Numerous other structures, such as wasteways, drops, bridges, etc., were also built on these laterals.

Several laterals of this system were cleaned out, enlarged, and extended to the system below, in order that all waste water might be utilized. Several other small laterals were also built which will eventually be fed from the Ironstone canal system.

LOUTSENHIZER CANAL SYSTEM.

The Loutsenhizer Canal was the third largest of all the private canals that diverted water from the Uncompahgre River. At the time of purchase the system included 26.3 miles of main line and 12.3 miles of laterals. The Loutsenhizer Canal was built in 1883 by O. D. Loutsenhizer and subsequently purchased, enlarged, and extended by the Loutsenhizer Canal Co. The canal was purchased by the United States in September, 1908.

The Loutsenhizer canal system as now developed irrigates all lands between the South and Selig Canal systems, and includes 7.35 miles of main line and 15.85 miles of laterals. The old headworks were replaced with a timber structure controlled by six 3.5 by 4 foot wooden gates operated by handwheel hoists, the sluiceway being controlled by a 7.5 by 6 foot steel gate operated by a geared hand hoist. The old timber flume over Cedar Creek was replaced with a new timber structure 96 feet long and two timber chutes were built to replace shale drops having a total fall of 72 feet. The old timber dam was repaired and an apron added, and a foot bridge built across the river. A section house was built at the headworks. A feeder channel was built out of Cedar Creek into the main line. Numerous other minor structures were built to replace minor structures on the old ditches.

SELIG CANAL SYSTEM.

This system will irrigate all lands on the east side of the Uncompahgre River between the Loutsenhizer and East Canal systems. The old Selig or Eckerly Canal was acquired by the Government during 1914 and irrigated a few thousand acres on North Mesa. The main line of the new system follows the old canal for a distance of 3.4 miles and is 19.63 miles long, being divided for construction purposes into three divisions as follows: Selig Canal, 3.36 miles long; Upper Selig Extension Canal, 3.73 miles long; and the Lower Selig Extension Canal, 12.54 miles long, The excavation of the Selig and nearly all of the Upper Selig Extension Canals was accomplished under a formal contract dated August 7, 1914, involving the excavation of 180,362 cubic yards. Schedule 9, or the chute section of the Upper Selig Extension Canal, was excavated under an informal contract dated May 29, 1914, 3,001 cubic yards being excavated. The controlling works out of the Uncompahgre River are located near a county bridge and the river is confined to a fixed channel by means of sheet piling, which connects both ends of the controlling works with the bridge abutments. The headworks proper is a timber structure, supported on a pile foundation, and the flow is controlled by 12 gate openings 3 feet 2 inches wide by 4 feet high, operated by handwheel hoists. The river-controlling works consist of a collapsible flashboard dam of 21 frames supported on a pile foundation, the flashboard frames being operated from a bridge. The main line is carried under the railroad by a lined channel, the tracks being supported by 20-inch I-beams. Combination timber flumes and drops were built to carry the main line and Upper Selig Extension over Cedar Creek and the Loutsenhizer arroyo, respectively. A timber chute 1,021 feet long was built on Schedule 9 of the Upper Selig Extension Canal. Five timber drops and other minor structures were also built on these canals.

The Eckerly lateral diverts from the main line at the beginning of the Upper Selig Extension Canal. This lateral has a maximum capacity of 90 second feet and length of 7.57 miles. Its excavation, together with the excavation of 8.32 miles of sublaterals and the building of the necessary structures, was accomplished by Government forces.

An informal contract was entered into under date of January 30, 1915, for the excavation of Lateral No. 3 of the Upper Selig Extension Canal, 14,533 cubic yards being excavated.

A formal contract was entered into under date of December 22, 1913, for the excavation of the Lower Selig Extension Canal between station 0 and station 120, 29,675 cubic yards being excavated.

A formal contract was entered into under date of May 10, 1913, for the excavation of the Lower Selig Extension Canal between station 120 and station 466+75, and the excavation of 3.4 miles of the Peach Valley lateral. This work involved the removal of 191,080 cubic yards and the driving of 930 linear feet of tunnel.

Two formal contracts were entered into, one under date of February 5, 1915, and the other under date of February 6, 1915, for the excavation of the Lower Selig Extension Canal, between station 466+75 and station 704+50, and the excavation of laterals and sublaterals on this canal; this work involved the excavation of 110,928 cubic yards. The completion of the Lower Selig Extension Canal required the lining of the four tunnels with concrete and the building of concrete approaches to these tunnels; the building of a combination timber flume and drop; the building of two flumes with concrete approaches, one of No. 168 flume, 608 feet long, and the other of No. 156 flume, 459 feet long; and the building of other minor structures. All structures on this system were built and several small laterals, not previously listed, were excavated by Government forces.

IRONSTONE CANAL SYSTEM.

The Ironstone Canal system will irrigate all lands on Ash and California Mesa below the Montrose and Delta system. The Ironstone ditch, the second largest private ditch diverting from the Uncompahgre River, was not acquired by the service until the summer of 1915. No construction work was, therefore, accomplished until the fall of that year, except for the building of a few minor laterals fed from old laterals of the Montrose and Delta Canal system. Up to that time considerable survey work was accomplished in locating alternate lines in the event the old ditch would not be unified.

EAST CANAL SYSTEM.

This system will irigate all lands on the east side of the Uncompahgre River between the Selig and Garnet Canal systems. Its development utilized the lower portion of the old Loutsenhizer ditch and laterals. The main line has a length of 10.57 miles and a capacity of 325 second-feet. The excavation of schedules 1, 3, and 7 was accomplished by Government forces, 35,350 cubic yards being removed. A formal contract was entered into under date of August 30, 1913, for the excavation of 3.3 miles of the main line, involving the removal of 81,367 cubic yards. The dredging excavation of schedules 6 and 8 of the old Loutsenhizer ditch was accomplished under a formal contract dated December 14, 1911, involving the excavation of 87,067 cubic yards.

An informal contract dated July 27, 1912, was entered into for the completion of the excavation on the main line; 8,347 cubic yards were excavated. All five laterals from the main line, having a total length of 16.21 miles, were excavated by Government forces. The controlling works consist of two collapsible dams, 1,076 linear feet of sheet piling to confine the river in a fixed channel, and a headworks. The collapsible dams are suported on a pile foundation, each dam consisting of 16 frames, which are raised and lowered from an operating bridge. The headworks are supported on a pile foundation and controlled by 10 wooden gates 3 feet 2 inches wide by 4 feet high. The main line parallels the river for a short distance, and in order to prevent erosion of the banks it was necessary to build 480 linear feet of sheet piling protection. A timber wasteway was built near the headworks. A concrete-lined channel carries the canal under the railroad tracks, the tracks being supported on 20-inch I-beams. Division 3 through the town of Olathe was lined for its entire length of 3,900 linear feet with a bench flume in order to prevent excessive seepage. Two No. 228 semicircular steel bench flumes, having a total length of 832 linear feet, were built to carry the main line over arroyos. Numerous other minor structures were also built.

An informal contract was entered into under date of December 14, 1914, for the excavation of the East Canal waste ditch; 4,461 cubic yards were excavated. The end of the main line marks the beginning of the Cade and Union laterals.

A formal contract was entered into under date of September 4, 1914, for the excavation of the Cade and Union laterals and their four sublaterals. These laterals have a total capacity of 170 second-feet, a length of 26.49 miles, and their excavation involved the removal of 132,336 cubic yards.

An informal contract was entered into under date of September 10, 1914, for the excavation of schedules 1, 2, and 4 of the Garnet Mesa siphon trench; 13,060 cubic yards were excavated. The excavation of the blow-off trench and of schedules 3 of the siphon trench was accomplished by Government forces; 2,159 cubic yards were excavated. A contract was entered into under date of August 29, 1914, for furnishing and erecting 8,560 linear feet of 32-inch continuous metal-banded pipe for the Garnet Mesa siphon.

Two informal contracts were entered into, one under date of November 21, 1914, and the other December 8, 1914, for the excavation of the 2.92 miles of the Orchard Mesa lateral, which also included the excavation of the Orchard Mesa siphon trench. An informal contract was entered into under date of January 27, 1915, for furnishing and erecting 1,764 linear feet of 17-inch machine-banded pipe for the Orchard Mesa siphon.

An informal contract was entered into under date of February 12, 1915, for the excavation of the Orchard Mesa siphon blow-off trench; 1,795 cubic yards were excavated. Concrete approaches were built at both ends of the siphons on this system, and in order to prevent seepage it was necessary to line the lateral with bench flume at both ends of the Orchard Mesa siphon; a total of 620 linear feet of flume was placed. Numerous minor structures were built on these laterals. All structures on the East Canal system were built by Government forces.

GARNET CANAL SYSTEM.

This private system, which diverts water out of the Uncompahgre River several miles south of the town of Delta and irrigates all lands below the East Canal system, was turned over to the Government for operation during September, 1914. Considerable work was required to put the system on a serviceable basis. A tail ditch was excavated, the main line and laterals brushed out, old structures replaced or repaired, and measuring devices installed. All work was accomplished by Government forces.

TAYLOR PARK RESERVOIR.

During the summer of 1904 plane-table surveys were made at the Taylor Park Reservoir site on the Taylor River. During the summer and fall of 1911 a log cabin and log stable were built near the proposed dam site preparatory to the commencement of an investigation of the foundation materials at the dam site. Twelve test pits were also dug along the hillsides above the dam site in order to determine the character of material available in case a hydraulic fill dam was decided upon. During the summer of 1912 the topographic, placer claim, section line, contour, and traverse surveys were run out and work was commenced on the diamond drilling, which was completed during the following summer. Nine holes in all were driven, four at the upper and five at the lower dam site. These holes varied from 37 to 103 feet in depth. The survey of the Taylor Park cut-off road, having a total length of 4.56 miles, was run out during the summer of 1913.

CONSTRUCTION DURING FISCAL YEAR.

Taylor Park Reservoir.—No construction work was accomplished. Hydrographic investigations were continued.

Gunnison River weir.—The collapsible steel flashboards were installed.

Gunnison Tunnel.—The main shaft and small shaft of the Gunnison Tunnel were sealed up with concrete and back filled. The inclined ventilating shaft was also back filled. The hydrographic determinations were continued.

South Canal system.—No construction work was accomplished on the main line. A few measuring devices and other minor structures and a timber chute were built on the lateral system.

West Canal system.—A permanent feeder ditch out of the Uncompahgre River to the West Canal was built. The excavation of this ditch was accomplished under an informal contract entered into under date of November 6, 1915, with J. D. Brock and F. E. Wiggins. This work was completed in December; 984 cubic yards were excavated. The feeder ditch headworks and sluiceway were built by Government forces. Miscellaneous minor structures, such as measuring devices, etc., were built on the lateral system.

Montrose and Delta Canal system.—The Chipeta ditch was turned over to the United States for operation by the service during the spring of 1916; considerable work was accomplished on this lateral in clearing and grubbing and replacing of old structures. Several small laterals were extended in order to provide wasteways into the Ironstone Canal system. A connecting ditch 2,300 feet long between the old High Mesa and East Coal Creek laterals was built; three drops and one chute were built on this connecting ditch. Miscellaneous minor structures, such as drops, bridges, measuring devices, etc., were built or replaced on the lateral system.

Loutsenhizer Canal system.—The North Mesa Lateral Extension Siphon was completed during the year. The excavation of the siphon and blow-off trenches was accomplished under an informal contract with the Orman Construction Co., dated September 22, 1915; this excavation work was completed in November, 1,948 cubic yards being excavated. The siphon pipe was purchased under an agreement with the Pacific Tank & Pipe Co., dated November 10, 1916, and consisted of 1,727 linear feet of 20-inch metal-banded redwood stave pipe with inserted joints. The siphon pipe was installed and trench back filled by Government forces. Concrete approaches to the siphon were built, and the 8-inch spiral riveted steel blow-off pipe, 632 feet long, was installed and trench back filled during March. The lateral at both ends of the siphon was lined with No. 60 semicircular Maginnis smooth interior flume, in order to prevent seepage through the mesa; a total of 1,935 linear feet of flume was placed. Miscellaneous minor structures, such as drops, bridges, measuring devices, etc., were built, or replaced on the lateral system. During the year right of way for ditches was obtained as required, and 11 second-feet of outstanding Loutsenhizer water rights were purchased. At the close of the year the United States has acquired approximately 72 per cent of these outstanding water rights.

Selig Canal system.—The building of timber drops, bridges, head gates, chutes, spill flumes, measuring devices, etc., on the Lower Selig Extension Canal and laterals was completed. The Peach Valley lateral was located, and under date of March 16, 1916, a formal contract was entered into with the Orman Construction Co. for its excavation, involving the removal of 56,200 cubic yards in a total length of 9½ miles of canal. This excavation work was not completed during the fiscal year. The building of the structures required on the Peach Valley lateral was begun during the fiscal year. Miscellaneous timber structures, such as drops, bridges, turnouts, wasteways, checks, flumes, measuring devices, and other minor structures were built on the lateral system.

Ironstone Canal system.—The final location, profile, cross section, right of way, and mile post surveys for the main line and a portion of the lateral system were completed. The right of way along the main line of the Ironstone Canal was cleared and grubbed by Government forces. A contract was entered into under date of November 18, 1915, with Mendenhall, Bird & Co. for the excavation of schedules 1 and 2 of the main line. This work was completed in March; 120,039 cubic yards were excavated. A contract was entered into under date of November 13, 1915, with C. B. Sherwood for the excavation of schedules 3, 4, and 5 of the main line. This work was completed in April; 101,163 cubic yards were excavated. The main line is 11 miles in length.

The controlling works out of the Uncompahgre River were built during the fiscal year and consist of a headworks, control weir, and wasteway, all timber structures. The headworks and control weir are located at the base of a U-shape bend in the Uncompahgre River; the wasteway is located at the upper end of one of the arms and acts as relief structure and sluiceway to the headworks. The wasteway is supported on a pile foundation with sheet piling protection wings, and the flow is controlled by four built-up steel roller gates 7 feet 6 inches wide by 6 feet high, operated by handwheel hoists. The headworks proper is supported on a pile foundation, and the flow is controlled by 10 gate openings 3 feet 2 inches wide by 4 feet high in the clear, operated by handwheel hoists. Two of the gate openings are used as a diversion for the Satisfaction Canal. The river is confined to a fixed channel by sheet piling wings. The river-controlling works consist of a weir supported on a pile foundation, the river flow being controlled by means of needles placed in position from an operating bridge. A sluiceway gate similar to the wasteway gate was installed at the headworks end of the control weir. The main line is carried over Dry Creek by a wooden flume 14 feet wide and

92 feet long, supported on a pile foundation. The channel of Dry Creek was straightened out at this point, involving the removal of 3,000 cubic yards. A timber bench flume 664 feet long and 20 feet wide was built in the main line sidehill section to prevent a break in the canal due to sliding banks.

The enlargement of the Ash Mesa lateral and its sublaterals was completed for a distance of 736 miles; 48,353 cubic yards were excavated. The following timber structures were also built on this system: Ash Mesa headgate and drop, 52 drops, 33 bridges, 71 turnouts and measuring devices, 28 crossover flumes, 7 underdrains, 2 culverts, 2 combination structures, and 1 check. The necessary right of way was obtained as required on the main line and lateral system. Agreements were entered into for the transfer to the United States of 70 per cent, or 225 shares of the Ironstone Ditch stock.

East Canal system.—Miscellaneous minor structures, such as turnouts, cross-over flumes, drops, wasteways, checks, culverts, bridges, and measuring devices were built on the lateral system.

Garnet Canal system.—No construcion work was accomplished on this system except for the building of a timber wasteway.

Drainage system.—The preliminary field surveys of the seeped areas in the California Mesa, Ash Mesa, North Mesa, and Happy Canyon districts were begun. This work embraced the running out of 53.42 miles of profile line and the boring of 538 test holes in which to observe and measure the fluctuation in the ground-water elevation. Thirty-two linear feet of the 8-inch experimental tile drain along the South Canal were taken up, examined, and replaced with new tile.

Irrigable land surveys.—The field work in connection with the measurement and classification of the irrigable area and the office mapping work was prosecuted continuously throughout the year, and is about 80 per cent completed.

Permanent improvements and land.—Very little construction work was accomplished under this feature, except for some minor additions to existing section houses and for the removal and remodeling of the Ironstone headworks section house.

SEEPAGE AND DRAINAGE.

Considerable areas in the Uncompahgre Valley are suffering from an excess of ground water, largely caused by excessive and careless use of irrigation water. This condition is no doubt aggravated by the system in use of furnishing water on a continuous flow basis. The seeped lands are by no means confined to the river bottom. About 6,500 acres have been drained in the valley. Some of this work was performed by the individual farmers, but all the large undertakings were carried through by the drainage firm of Elliott & Meaker. The cost per acre for drainage varies from $25 to $75, depending upon the distance the tile trenches have to be carried before securing an outlet.

No drainage construction has been accomplished by the service. The preliminary drainage surveys were begun during the spring of 1915.

ECONOMIES OF GOVERNMENT WORK.

On March 22, 1909, proposals were issued for the reconstruction of schedule 18 of the South Canal. Only one bid was received for this work at an approximate price of $35,000. This bid was rejected and a portion of the work readvertised, the balance being accomplished by Government forces. The total cost of the work as completed amounted to $29,986.82.

On October 21, 1912, only one bid was received for the excavation of schedule 2 of the West Canal extension approximating $15,175. This bid was rejected and work readvertised. The total cost of the work as completed amounted to $11,222.40.

BOARD AND OTHER REPORTS.

Date.	Subject.	Personnel.
Oct. 18, 1901	Geological report on State tunnel location.	Whitman Cross.
May 13, 1904	Feasibility of Uncompahgre Valley project.	A. P. Davis, George Y. Wisner, W. H. Sanders.
July 10, 1904	Plans and specifications of Gunnison Tunnel.	W. H. Sanders, George Y. Wisner, J. H. Quinton, I. W. McConnell.
November, 1904	Geological formation of Vernal Mesa	C. E. Siebenthal.
September, 1905	Rejection of bids, second advertisement Gunnison Tunnel.	W. H. Sanders, J. H. Quinton, C. H. Fitch, I. W. McConnell.
Sept. 15, 1905	Report on bids for excavation of South Canal.	W. H. Sanders, J. H. Quinton, A. L. Fellows.
Jan. 5, 1910	Alkali investigations	J. Y. Jewett.
Nov. 12, 1912	Concrete lining in Gunnison Tunnel and South Canal.	D. C. Henny, R. F. Walter, C. T. Pease.
Feb. 27, 1913	Progress, Uncompahgre Valley Project	A. P. Davis, R. F. Walter, C. T. Pease.
July 15, 1913	Agricultural and economic inspection report, Uncompahgre Valley project.	F. W. Hanna.
Aug. 27, 1913	Disintegration of concrete	A. P. Davis.
Nov. 21, 1914	Unification report	I. D. O'Donnell.
Dec. 12, 1914	Uncomphgre Valley project	I. D. O'Donnell, D. C. Henny, R. F. Walter, F. D. Pyle.
Dec. 14, 1914	Uncomphgre water supply	D. C. Henny, C. T. Pease, R. F. Walter, F. D. Pyle.
Do	Gunnison Tunnel capacity	D. C. Henny, C. T. Pease, R. F. Walter, F. D. Pyle.
1915	Board of Review report	P. J. Preston, C. T. Pease, Geo. W. Bruce.

OPERATION AND MAINTENANCE.

During the season of 1915 the Reclamation Service supplied and distributed water for the irrigation of 41,463 acres of land, 4,041 acres of which were supplied from the South Canal system; 3,678 acres from the West Canal system; 20,628 acres from the Montrose & Delta Canal system; 3,991 acres from the Loutsenhizer Canal system; 3,874 acres from the Selig Canal system; 3,740 acres from the East Canal system; and 1,511 acres from the Garnet Canal system. The following private canals, the owners of which have entered into agreements to transfer them to the United States, were supplied with Gunnison water: Logan, Chipeta, North Mesa, Homerun, and Delta Chief.

During the season 264,060 acre-feet of water were diverted into canals operated by the service, 231,271 acre-feet of this amount being delivered to the land. All water was furnished on a continuous flow rental basis; the charge was $80 per second-foot per season for all consumers under all canal systems, except as noted below. The consumers under the Loutsenhizer, Selig, and East Canal systems, who possessed water rights in the old Loutsenhizer ditch, were furnished water at the rate of $20 per second-foot for Uncompahgre priority water and $60 additional per second-foot for Gunnison water. A few consumers under the Montrose & Delta Canal system were furnished Uncompahgre priority water at rates varying from $36 to $40, depending upon the terms of the contracts they held with the old canal company. Private canals were furnished Gunnison water at the South Canal outlet at the rate of $60 per second-foot per season.

No particular difficulties were experienced in the operation of the Gunnison Tunnel, West, Loutsenhizer, and Garnet Canal systems. During the spring floods the usual expense was undergone in protecting canal head gates and in preventing them from clogging up with drift and other foreign material. The South Canal was shut down at nine different times for a total of 34½ days to make repairs to the South Canal outlet, to the concrete lining below drop No. 3 of series No. 1, and to the concrete lining between Tunnels 1 and 2. At the close of the irrigation season extensive repairs were made to the concrete lining between Tunnels Nos. 1 and 2, 1,300 linear feet of new lining being placed on top of the old concrete lining. Irrigation from the West Canal system started additional slides on the upper slope of the Montrose and Delta Canal in the sidehill section, necessitating the building of additional drains to relieve the condition. A break occurred in the canal bank of the King lateral extension, and a flume sheet failed in one of the flumes on this lateral, necessitating a shutdown of one and one-half days to make the necessary repairs. The sidehill section of the Selig Canal, a few miles below the head gate, gave considerable trouble due to the slipping banks. A small flood washed around 16 drops on the laterals of the lower Selig Extension Canal. Several drops on the new laterals of the East Canal system were washed out and replaced.

During the irrigation season the operating force was employed in regulating the distribution of water and in making minor repairs, and during the remainder of the year, weather permitting, the same force was engaged in clearing the canals of vegetable growth and deposits of sand and gravel and in repairing and installing minor structures.

Historical review, Uncompahgre Valley project.

Item.	1911	1912	1913	1914	1915	1916[1]
Acreage for which service was prepared to supply water	30,000	44,500	48,000	52,338	62,147	85,000
Acreage irrigated	20,995	27,887	31,428	33,873	41,463	55,000
Miles of canal operated	131.0	210.7	228.0	279.5	355.8	400.0
Water diverted, acre-feet	112,708	139,932	182,191	183,342	264,060	330,000
Water delivered to land, acre-feet	113,789	133,912	160,056	171,268	231,271	288,750
Per acre of land irrigated, acre-feet	5.44	4.81	5.09	5.06	5.56	5.25

[1] Estimated.

SETTLEMENT.

No public land under this project is open to entry and no public notices have been issued, except the general public notice issued September 24, 1914. One hundred and sixty-eight farm units were opened for entry by the Secretary of the Interior on September 1,

1915. Seventy of these units were filed on and the remaining unentered units were again withdrawn from entry by the Secretary on October 8, 1915. The only settlement that has taken place during the year has been due to the transfer of private lands, to the subdivision into smaller tracts of the larger holdings, and to the additional farm units entered under the land-opening order of September 1, 1915. An agricultural adviser was assigned to the project on October 10, 1915; his efforts, for the present, are being confined to the promotion of the live-stock industry.

There is no experiment farm on the project, but considerable interest is manifested in the work the Colorado Agricultural College is accomplishing in experimental work. Once each year an agricultural special train passes through the State and spends several hours in each of the principal agricultural towns. Exhibits of various crops are shown and lectures given, and this yearly demonstration has proven to be of great interest and success. Specialists have been sent out by the United States Department of Agriculture, the Colorado State Agricultural College, and the agricultural department of the Denver & Rio Grande Railroad Co. to effect permanent organizations in all of the principal towns in the interest of "better farming." Practical domestic science clubs have been established in a number of the schools. The Grange Cooperative Association, the members of which belong to the four leading granges of the valley, is in a flourishing condition. The Western Slope Fair is held annually at Montrose during September and has been a financial success.

Settlement data, Uncompahgre Valley project.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	1,245	1,344	910	1,107	
Population	5,171	4,265	2,942	3,561	
Number of irrigated farms	1,245	1,344	910	1,107	
Operated by owners or managers	(1)	839	551	615	
Operated by tenants	(1)	505	359	492	
Population	5,171	4,265	2,942	3,561	
Number of towns	3	3	3	3	
Population	6,320	6,400	6,500	6,500	
Total population in towns and on farms	11,491	10,665	9,442	10,061	
Number of public schools	24	26	22	24	
Number of churches	(1)	22	26	26	
Number of banks	(1)	(1)	8	8	8
Total capital stock	(1)	(1)	$425,000	$360,000	$360,000
Total amount of deposits	(1)	(1)	$1,692,612.64	$1,556,963.15	$2,083,999.48
Total number of depositors	(1)	(1)	5,950	5,975	8,000

(1) No data.

The data given for the years 1914 and 1915, under items 1 to 6, apply only to the farms irrigated from canals operated by the service. The data for other years include farms irrigated from private canals.

CROPS.

The year 1915 was a fair crop year; fair prices were received, and as a result the general prosperity and financial condition of the valley were improved to a certain extent. This improvement is also due to the fact that a large number of farmers entered into the live-stock industry on a small scale. Alfalfa, wheat, oats, potatoes, apples, and sugar beets had the largest acreage in the order named. Onions, alfalfa seed, apples, small fruits, and potatoes gave the largest return per acre of crop. Alfalfa, potatoes, wheat, apples, sugar beets, and oats gave the largest percentage of the total returns. The increased acreage of alfalfa was due to the increase in the live-stock industry and to the realization of the value of alfalfa as a rotation crop. The increased acreage of sugar beets was due to increased prices offered by the sugar company. The increased acreage of corn was the largest of any crop and was due to the increase in the hog industry. The increased acreage of wheat was due to the high prices prevalent. The decreased acreage of oats and potatoes was due primarily to the low prices that prevailed for the past few years. The decreased yields in practically all crops were due to the spring frosts and the exceptionally dry midsummer. Grasshoppers caused considerable damage to crops in certain sections of the project. The crop outlook for 1916 is good. The yield of the first cutting of alfalfa will be below normal, due to the cool weather prevailing during the spring. The spring frosts seriously injured the fruit crop. All other crops are in excellent condition.

Crop report, Uncompahgre Valley project, Colorado, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa hay	16,611	Ton	43,489	2.6	$6.01	$261,361	$15.73
Alfalfa seed	14	Bushel	140	10.0	9.57	1,340	95.71
Apples	1,732	Pound	9,939,500	5,739	.014	138,413	79.91
Barley	345	Bushel	8,873	25.7	.66	5,887	17.06
Beans	148	...do	1,862	12.6	2.56	4,773	32.25
Beets, sugar	1,723	Ton	12,355	7.2	5.03	62,205	36.10
Clover hay	131	...do	222	1.7	6.58	1,460	11.15
Clover seed	1	Bushel	12	12.0	4.08	49	49.00
Corn, Indian	1,167	...do	36,734	31.5	.85	31,275	26.80
Corn, fodder	282	Ton	856	3.0	4.46	3,815	13.53
Fruits, small	66	Pound	66,475	1,007.0	.073	4,841	73.34
Garden	160					9,221	57.63
Hay	353	Ton	650	1.8	6.72	4,368	12.37
Oats	5,385	Bushel	143,240	26.6	.41	59,176	10.99
Onions	225	...do	56,950	253.1	.58	32,888	146.17
Pasture	1,267					11,020	8.69
Peaches	174	Pound	215,540	1,239	.018	3,938	22.64
Pears	13	...do	18,800	1,446	.030	567	43.62
Peas	40	Bushel	735	18.4	.72	530	13.25
Prunes	18	Pound	25,100	1,395	.022	557	30.94
Potatoes, white	3,775	Bushel	630,332	166.9	.39	244,961	64.89
Rye	33	...do	528	16.0	.88	466	14.12
Wheat	7,218	...do	176,731	24.5	.88	155,373	21.53
Miscellaneous	168	...do				6,431	38.28
Less duplicated areas	496						
Total cropped acreage	40,553	Total and average				1,044,915	25.76

Irrigated, not cropped:	
Nonbearing orchard	1,105
Young alfalfa	1,662
Ground fall plowed	1,047
Miscellaneous	108
Less duplicated areas	3,012
Total irrigated acreage	41,463

Areas.	Acres.	Farms.	Per cent of project.
Total irrigable area farms reported	62,147	1,107	44
Total irrigated area farms reported	41,463	1,107	30
Under rental contracts	41,463	1,107	30
Total cropped area farms reported	40,553	1,107	29

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 701.]

Feature costs of Uncompahgre Valley project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys		$96,461.45
Storage works (Taylor Park dam)		12,698.92
Canal system:		
Diversion dam and headworks	$115,604.64	
Gunnison Tunnel	2,988,913.57	
South Canal	856,844.28	
		3,961,362.49
Lateral system:		
South	46,768.91	
West	268,023.39	
Montrose & Delta	547,676.00	
Loutsenhizer	109,097.70	
Selig	335,049.27	
Ironstone	239,088.98	
East	259,867.95	
Garnet	4,920.62	
		1,810,492.82
Drainage system		2,792.35
Power system (preliminary and general work)		273.85
Farm units		24,524.22
Permanent improvements and lands		58,109.76
Telephone system		6,788.48
Operation and maintenance during construction (water rental basis)		505,547.09
Plant accounts		4,588.60
Gross cost of construction of project to June 30, 1916		6,483,640.03
Less revenues earned during construction period:		
Rental of buildings	18,390.98	
Rental of irrigation water	369,741.51	
Contractors' freight refunds	2,646.66	
Other revenues, unclassified	5.00	
Profit on mess-house operations	7,575.31	
Profit on mercantile store operations	20,419.44	
Profit on hospital operations	3,228.68	
		422,007.58
Net cost of construction of project to June 30, 1916		6,061,632.45

Estimated cost of contemplated work, Uncompahgre Valley project, during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examination and surveys		$1,000.00
Storage system		1,000.00
Canal system:		
Gunnison River weir	$300.00	
Gunnison Tunnel	6,700.00	
South Canal system	13,000.00	
		20,000.00
Lateral system:		
South Canal lateral system	2,000.00	
West Canal system	2,000.00	
Montrose & Delta Canal system	3,000.00	
Loutsenhizer Canal system	20,000.00	
Selig Canal system	15,000.00	
Ironstone Canal system	100,000.00	
East Canal system	3,000.00	
Garnet Canal system	800.00	
		145,800.00
Drainage system		5,000.00
Farm units		7,500.00
Permanent improvements and land		2,000.00
Telephone system		100.00
Operation and maintenance during construction (water rental basis)		60,000.00
Operation and maintenance under public notice		50,000.00
Messes		3,000.00
Mercantile stores		400.00
Hospitals		1,600.00
Total		297,400.00

IDAHO, BOISE PROJECT.

D. W. COLE, senior engineer, Boise, Idaho.

LOCATION.

Counties: Ada, Boise, Canyon, and Elmore.

Townships: 1 S. to 5 N., Rs. 6 W. to 6 E., Boise meridian, and Tps. 21 and 22 S., R. 46 E., Willamette meridian.

Railroads: Oregon Short Line; Boise, Nampa & Owyhee, and Idaho Northern (now branches of Oregon Short Line); Boise Valley Traction; Caldwell Traction; Boise & Arrowrock, and Intermountain.

Railroad stations and estimated population January 1, 1916: Boise, 25,000; Nampa, 4,500; Caldwell, 4,500; Meridian, 650; and Kuna, 200.

WATER SUPPLY.

Source of water supply: Boise River.

Area of drainage basin: 2,610 square miles.

Annual run-off in acre-feet of Boise River near Highland (2,610 square miles), 1895 to 1915: Maximum, 3,829,800; minimum, 1,119,530; mean, 2,185,012.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water season of 1916: 230,000 acres, including 20,422 acres of land in territory of New York Canal Co.

Area under water-right applications and rental contracts season of 1916: 118,000 acres.

Area under special contracts: 80,000 acres.

Length of irrigation season: From April 1 to October 31—214 days.

Average elevation of irrigable area: 2,500 feet above sea level.

Rainfall on irrigable area: At Boise station for 33 years, average, 12.71 inches; 1915. 13.31 inches.

Range of temperature on irrigable area: —28° to 107° F.

Character of soil of irrigable area: Clayey loam, light sandy loam, and sandy loam.

Principal products: Alfalfa, wheat, oats, potatoes, apples, prunes, and small fruits.

Principal markets: Boise, Nampa, Caldwell, and Meridian, Idaho; Portland, Oreg., and eastern cities.

LANDS OPENED FOR IRRIGATION.

The project has not yet been formally opened.

Limit of area of farm units: Public, 80 acres; private, 160 acres.

CHRONOLOGICAL SUMMARY.

Reconnoissance made and preliminary surveys begun in 1902.

Construction recommended by board of engineers February 15, 1905.

Construction authorized by Secretary, March 27, 1905.

Main canals of New York Canal Co. and Idaho-Iowa Lateral & Reservoir Co. acquired March 3, 1906.

First irrigation by Reclamation Service, season of 1906.

Boise River Dam completed September, 1908.

Arrowrock Dam completed November, 1915.

Upper Deer Flat embankment completed March, 1911.

Deer Flat Forest embankment completed June, 1911.

Lower Deer Flat embankment completed January, 1912.

Boise River power plant completed May, 1912.

Pioneer district drainage completed June, 1916.

Pioneer and Nampa & Meridian districts cooperative drainage begun December, 1915, and 50 per cent completed June 30, 1916.

Nampa & Meridian district drainage begun December, 1915, and 40 per cent completed June 30, 1916.

Project 90 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Boise project provides for storage of water in the Arrowrock Reservoir on Boise River, about 22 miles above Boise, and in the Deer Flat Reservoir near Caldwell and Nampa, Idaho; the diversion of water from Boise River by the Boise River Dam, about 8 miles above Boise; the distribution of water on the south side of Boise River, through the Main Canal, leading from the dam to the Deer Flat Reservoir; distributing laterals heading in the Main Canal; distributing canals heading in the Deer Flat Reservoir; and distributing canal systems heading in the Boise River below the Boise River Dam; and the distribution of water on the north side of the Boise River to a small area of land east of Boise through a canal system heading at the Boise River Dam. The United States claims all waste, seepage, spring, and percolating water arising within the project, and proposes to use such water in connection therewith.

SUMMARY OF GENERAL DATA FOR BOISE PROJECT TO JUNE 30, 1916.

Areas:			
Irrigable acreage when project is complete			255,000
Public land entered June 30, 1916			73,785
Public land open to entry June 30, 1916			420
State land June 30, 1916			8,700
Private land June 30, 1916			172,095
Acreage Service could have supplied season of 1915			207,000
Estimated acreage Service can supply July 1, 1917			230,000
Acreage actually irrigated season of 1915			97,127
Acreage cropped under irrigation season of 1915			90,240
Crops:			
Value of irrigated crops season of 1915			[1] $1,526,873
Value of irrigated crops per acre cropped			$21.87
Finances:			
Estimated cost of completed project			$12,800,000
Total construction cost to June 30, 1916			$11,498,547.82
Per cent complete June 30, 1916			90
Appropriation for fiscal year 1917, total			$650,000
Allotment for construction fiscal year 1917			$435,000
Estimated per cent complete June 30, 1917			93
Appropriation fiscal year 1916		$1,650,000.00	
Decrease under 10 per cent provision of act		59,000.00	
Total appropriation			$1,591,000.00
Expenditures during fiscal year chargeable to 1916 appropriation—			
Disbursements	$616,315.68		
Transfers	38,832.72		
		$655,148.40	
Registered liabilities chargeable to 1916 appropriation		86,407.91	
			$741,556.31
Unencumbered balance July 1, 1916			$849,443.69

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[1] From 69,818 acres on which crop census was taken.

Repayments:		
Water-rental charges—		
Accrued to June 30, 1916		$378,721.99
Collected to June 30, 1916		$359,136.34
Uncollected June 30, 1916		$19,585.65
Power earnings—		
Accrued to June 30, 1916		$50,312.46
Collected to June 30, 1916		$50,312.46
Drainage:		
Estimated acreage damaged by seepage to June 30, 1916		18,750
Miles of drains built to June 30, 1916—		
Open	96.6	
Closed	0.8	
Total		97.4
Estimated acreage protected by drains built to June 30, 1916		38,500
Estimated acreage to be protected by authorized system		83,500
Expended to June 30, 1916, for drainage works completed and uncompleted		$480,159.37

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

DEER FLAT RESERVOIR.

An important feature of the project is the Deer Flat Reservoir, situated about 4 miles west of Nampa, Idaho. To form this reservoir two dams were required, known as the Upper Deer Flat embankment and the Lower Deer Flat embankment. The upper embankment has a maximum height of 70 feet and a length of crest of 4,000 feet and contains 932,200 cubic yards of material. The lower embankment has a maximum height of 40 feet, a length of crest of 7,200 feet, and contains 936,600 cubic yards of material.

During the summer and fall of 1905 plans and specifications were prepared for the construction of the upper and lower Deer Flat embankments, the dam and diverting works on Boise River, and the main canal from the diversion dam to the Deer Flat Reservoir. In October, 1905, these plans and specifications were reviewed by a board of engineers consisting of Messrs. A. J. Wiley, D. C. Henny, D. W. Ross, and F. C. Horn and recommended to the department for approval and advertisement. Proposals for the construction of these works were opened February 1, 1906. All bids received for the construction of the Upper Deer Flat embankment were deemed excessive and were rejected, and construction by Government forces was authorized. The work was completed in September, 1908. A contract was awarded on June 16, 1906, for the construction of the Lower Deer Flat embankment, and this work was completed in January, 1908.

In November, 1910, a start was made in placing a gravel blanket on the upper embankment. This was finished in March, 1911, 101,400 cubic yards having been placed. In April a road was finished from the upper to the lower embankment along the flow line of the reservoir. A small embankment known as the Forest, containing 19,200 cubic yards of material, was placed at a point along this road, and the machinery moved over this road to the lower embankment, where a gravel facing, containing 226,400 cubic yards, was finished in January, 1912.

In February, 1913, a concrete tower was placed at the Deer Flat-Caldwell Canal outlet.

This completed the Deer Flat Reservoir.

BOISE DIVERSION DAM.

The diversion of water from Boise River into the main canal supplying water to distributing laterals and Deer Flat Reservoir is accomplished by means of a dam on Boise River about 8 miles southeast of Boise, Idaho. The dam is built of rubble concrete masonry founded on compact gravel and is 35 feet in height above the river bed and 400 feet in length. Proposals for the construction of the dam and diversion works were opened February 1, 1906, a contract was executed February 21, 1906, and the work completed in October, 1908. A contract for the gates, guides, and lifting devices to be used in the diversion tunnels and canal headworks was executed April 5, 1906, and delivery of the material was completed in April, 1907. The gates were installed by the contractor for constructing the dam and diverting works.

MAIN SOUTH SIDE CANAL.

The main canal of the project heads at the Boise diversion dam and follows the course of the canal acquired in 1906 from the New York Canal Co. and the Idaho-Iowa Lateral & Reservoir Co., a distance of 26 miles to Indian Creek. The waters are here discharged into the creek and conveyed through its channel for a distance of about 9 miles and there diverted into a new canal 8 miles in length, discharging into Deer Flat Reservoir. The construction of this canal consisted of enlarging portions of the existing canal from the headworks to Indian Creek and the construction of a canal from Indian Creek to Deer Flat Reservoir. The capacity of the canal before enlargement was about 200 second-feet and the capacity to which it was to be enlarged at this time was 1,500 second-feet. The proposals received on February 1, 1906, for the first part of the work, from the diversion dam to Indian Creek, were deemed unsatisfactory, but a contract was awarded at that time for the portion of the canal from Indian Creek to Deer Flat Reservoir. The contract was executed in February, 1906, and the work completed in March, 1908. The work of enlarging the canal from Boise River to Indian Creek as a part of the main canal, after the rejection of bids under specifications No. 68, was readvertised under specifications No. 79. Proposals were opened April 16, 1906, and two contracts for different parts of the work were executed on April 19 and May 12, respectively. The contract for the part of the work beginning at the diversion dam was completed in April, 1908. The contractor for the other portion of the work carried it on so unsatisfactorily that it was necessary to suspend the contract on October 27, 1908, after which time the work was done by Government forces and completed in January, 1909. During the years 1909 and 1910 parts of the canal were lined with concrete and concrete checks were constructed.

The enlargement of the main canal from 1,500 to 2,500 second-feet was begun in 1909 and completed by April, 1912. A 4-inch concrete lining was placed in stretches of various lengths where seepage was large between stations 0–412 and stations 924–953. The bottom width of the lined sections is 40 feet. Where not lined the capacity of the canal was increased by widening to a 70-foot base. The lining was done by Government forces; the larger portion of the excavation was let to Hay & Elzy and the Maney Bros., contractors.

In the fall of 1912 an additional small section was lined, making a total of 6.6 miles of lining on the main canal above Indian Creek. To prevent erosion, some additional stretches have been paved with dry masonry or riprap, and some stretches graveled. Near the heading, to give an increased section in that portion of the canal in which the water is picking up velocity, vertical walls of concrete and rubble masonry were placed on top of the lining.

DISTRIBUTING CANALS AND LATERALS.

The distributing canals and laterals constructed by the Reclamation Service include main distributing canals heading at the Deer Flat Reservoir outlets and the necessary lateral systems to convey the water to the irrigable lands, the enlargement and extension of existing laterals from the main canal, the construction of new laterals from the main canal, and the construction of a few new laterals from the Ridenbaugh Canal. Construction work was begun in 1908, the excavation being carried on mainly by contract and the structures being erected by Government forces. During the season of 1908 and 1909 a large part of the excavation of the laterals was done with the cooperation of the Payette-Boise Water Users' Association.

During the fiscal year 1910 contracts were let, involving the excavation of approximately 300,000 cubic yards of material. Numerous drops, weirs, checks, flumes, culverts, and bridges were built by Government forces. In the fiscal year 1911 the system was extended to cover 30,000 additional acres; in 1912, 35,000 acres; and in 1913, 5,000 acres.

The following important wasteways have been constructed or reconstructed of concrete since 1910: Melba and Richards Point from the Mora Canal; Fargo, Frohman, Lizard, and Valley Mound from the Deer Flat Lowline Canal; Golden Gate and State line from the Golden Gate Canal; and Hubbard Lake wasteway from the Main South Side Canal. Aside from these, less important wasteways have been constructed on nearly all of the principal laterals. Three large concrete pipe siphons have been installed, viz: The Forest, Chance, and Brock. Approximately 2 miles of concrete lining have been placed on the Deer Flat Lowline and Mora Canals.

DRAINAGE.

Under the provisions of a contract entered into with the Pioneer Irrigation District drainage work was begun in that district in November, 1913. Two electric drag-line excavators were placed on the work, which was completed in July, 1915. Open-drain ditches were dug in the natural depressions, and these have developed a considerable discharge to the Boise River. Great success has attended the work, and much of the land formerly water-logged has already been placed in cultivation without additional drainage by individuals.

On completion of the first contract with the Pioneer people a supplemental contract was entered into for cooperative drains which would carry the Nampa and Meridian irrigation district drainage water through the Pioneer district, and for such other drains as might seem desirable and for which the fund was sufficient. At this date all the drains provided for by the two contracts in the Pioneer district proper have been completed, involving the moving of 2,595,602 cubic yards of dirt and costing $253,539.55. Under the provisions of the cooperative drainage contract 288,649 cubic yards of dirt have been excavated, costing $37,069.02 to date.

Seepage developed in the Fargo Basin on the Snake River slope, and in September, 1914, one electric drag-line excavator was started on drainage work. This was completed in June, 1915. A total of 275,644 cubic yards of earth was moved, costing $37,643.17.

In December, 1915, construction of drains in the Nampa-Meridian irrigation district was begun. This work is still being prosecuted. To date 600,567 cubic yards of dirt and 1,889 cubic yards of rock have been excavated, costing $89,377.37.

ARROWROCK DAM (STORAGE UNIT).

The purpose of this work was the construction of the Arrowrock Storage Reservoir, by the building of Arrowrock Dam and spillway, to impound water for irrigation of the lands within the Boise project in Idaho.

The dam is located on the Boise River, upstream about 22 miles, in an easterly direction from the city of Boise, and 17 miles by railroad from Barberton, the end of the Oregon Short Line Railroad branch out of Boise. The dam is built at a point about 4 miles below the junction of the two forks of the river. The reservoir is practically 17 miles long, covers an area at maximum storage of 2,888 acres, and in shape resembles the letter Y due to the water backing up both forks. The capacity of the reservoir with movable crest weir gates raised is approximately 250,000 acre-feet.

In 1903 and 1904 reconnoissance surveys were made at several reservoir sites on the upper waters of the Boise River, which included rough surveys of several dam sites. Estimates of cost were made of storage works for the several sites, and in 1910 a party was sent out with a diamond-drill outfit to explore the foundations at the most promising dam sites. Through a process of elimination the Arrowrock site was chosen as the most favorable, and testing of the foundation was continued more in detail at this site during the latter part of 1910 and early part of 1911. Fifty-nine diamond-drill holes were sunk over the proposed foundation area and along the spillway, besides several test pits and tunnels to determine depth to bedrock and its character. In prosecuting this work one "Sullivan" steam outfit and three "American" hand rigs were used. The conclusions drawn from the results of testing were favorable and were upheld by the report of the noted geologist, Prof. W. O. Crosby, who inspected the site in 1910.

Description of Arrowrock Dam.—The dam is a concrete structure, built with a gravity section upon a curved plan, the radius of the upstream face being 672.5 feet. It rests upon a granite foundation of excellent quality, especially good in the lower portions, where it is subjected to the greatest loads. Bedrock in the old river bed is from 60 to 80 feet below the present river bed and the dam section has an area of about 1 acre at that depth. The dam is 348.5 feet high, 223 feet thick at its base, 15.5 feet thick at the thinnest point near the top, and carries a 16-foot roadway across its top, which is 1,100 feet long.

At a distance of 5 feet and 13 feet, respectively, from the upstream face of the dam is a row of grout holes at 10-foot centers across the entire length of the dam, drilled 26 feet into bedrock and grouted under pressure. These holes were drilled from the bottom of the upstream keyway and are for the purpose of cutting off any passage of water under the dam. In case water by chance finds a way past this "line of defense," provision is made for relieving the upward pressure exerted by drainage holes drilled 26 feet into bedrock at 10-foot centers and at a distance of 27.5 feet from the upstream face.

In order to drain the seepage water which may enter the concrete from the reservoir, 8-inch drainage conduits were formed in the concrete at 10-foot centers and at a distance of 12 feet from the upstream face. These conduits extend to within 10 feet of the top of the dam and convey any water which enters them to the inspection gallery, to which the rock drains also lead. Water is conveyed from the inspection gallery to the downstream face of the dam through 24-inch drains located at convenient points.

The inspection gallery occupies a position near the upstream face of the dam, its lowest level being about 20 feet above the river bed. At both abutments the gallery follows the foundation up the slope 10 to 20 feet away from the rock to an entrance at each end of the dam near the top. Entrance to this gallery is also made from a third point on the lava bench which is the natural approach to the dam. Aside from being a part of the drainage system, the inspection gallery makes possible drilling of other grout or drainage holes in case in the future a leak develops. It also allows for the inspection of the dam at all times.

Connecting with the inspection gallery and occupying positions just under the regulating outlets are the two operating galleries from which the balanced valves are controlled. These galleries are 16 feet from the upstream face of the dam, are 87 feet apart in vertical distance, and are connected by a spiral stairway built of reinforced concrete. The lower gallery runs under the lower set of regulating outlets only, while the upper one extends along the entire length of the dam, connecting with the inspection gallery at each abutment. The upper operating gallery gives access for the inspection of the upper portion of the dam.

Contraction joints are built at 150-foot centers, extending to the top of the dam from a point 215 feet below; at 50-foot centers from a point 130 feet below; and at 25-foot centers from a point 70 feet below. These joints were made by building alternate sections of the dam ahead of the others, allowing these to "set up" before filling in against them. Along these joints openings, called wells, were formed out; three near the bottom, decreasing to one near the top. The upstream "well" is 5 feet square, while the other two are 10 feet square. Five feet from the upstream face of the dam an annealed copper Z strip was placed in the joint to cut off the flow of water through it. Back of each upstream or second well a drain was formed in the joint which leads either to the inspection or operating gallery. The contraction joint wells were filled with concrete during cold weather, at a time when the concrete in the body of the dam was in a contracted state.

There are 25 outlets through the dam. At the elevation of the river bed, 248 feet below the top of the parapet, are 5 sluice outlets 60 inches in diameter, protected by a trash rack and controlled by 60 by 60 inch sliding gates, operated by oil pressure from the low level inspection gallery. One hundred and ninety-seven feet below the top of the parapet is a set of 10 outlets. Three of these are 72 inches in diameter, reinforced as penstocks for use in connection with the proposed future power development. The other seven are 52 inches in diameter. They will carry the flow of irrigation water through the dam. The outlets at this elevation are all protected by trash racks, and are controlled by 58-inch balanced valves operated from the lower operating gallery. One hundred and ten feet below the parapets is a set of 10 regulating outlets similar in all respects to the seven just mentioned with the exception of the trash-rack structure, which in this case is omitted. This set of outlets is controlled from the upper operating gallery.

Description of spillway.—The spillway is located at the north end of the dam in a granite cut. The weir occupies a position adjacent to the dam along the north bank of the reservoir, extending upstream for a distance of 402 feet. The water in entering the spillway channel flows over the weir at right angles to the direction of flow. It is given a high velocity by building the bottom of the channel on a steep grade, 12 per cent at the upper end and decreasing to 1 per cent at the lower end of the weir. The spillway is designed for a carrying capacity of 40,000 second-feet of water. The channel has a maximum width on the bottom of about 30 feet, 2 on 1 side slopes, and is lined with reinforced concrete anchored to rock. Contraction joints are spaced 30 feet apart in the lining. The channel carries the water past the dam and discharges it into Deer Creek, which flows into the Boise River about 800 feet below the dam.

The water surface in the reservoir is sustained at an elevation 6 feet above the crest of the weir by means of structural steel movable crest gates which rise and lower automatically or by hand manipulation of valves, as desired. There are six of these gates, each 62 feet long, separated by 6-foot piers.

The wagon road leading across the dam is carried over the lower end of the spillway channel by a 96-foot span, 16-foot roadway, steel highway bridge.

Description of log conveyor.—It is estimated that there are 3,000,000,000 feet of timber on the Boise River watershed above Arrowrock Dam. To provide a means for getting the logs out of the reservoir, over the dam, and into the river again a log conveyor has been built at the south end of the dam. It is designed for a capacity of 60,000,000 feet of logs per season, lasting from May 1 to July 15. The conveyor consists of a "lift," by which the logs are raised from the reservoir onto the log deck by cable loops; live rolls across the dam; an endless-chain chute 390 feet long on a 62.5 per cent grade; and a gravity chute 245 feet long on a 32 per cent grade.

The structures are built of reinforced concrete and structural steel. The "bull chain" is a 1½ by 2¼ by 8 inch B. B. chain carrying four-tooth spurs at 8-foot centers and operates at 85 feet per minute.

Construction.—Before beginning actual construction of the dam it was necessary to perform considerable work of a preparatory nature, including the construction of a telephone system, a railroad, a system of wagon roads, a power plant, a transmission line, a sawmill, a construction camp, and diversion works for carrying the river past the dam site during early construction. All work was performed by Government forces with the exception of the grading of the railroad.

Telephone system.—In order to facilitate the construction work it was necessary to establish a quick, reliable means of communication with the project office at Boise. The work of constructing a telephone line was started during February, 1911. The first circuit was finished April 18, 1911. Later it was found necessary to run a second circuit on the same poles to accommodate the business properly. The line follows the New York Canal from Boise to Barberton and the Arrowrock Railroad from that point to Arrowrock. Both lines are metallic circuit of No. 12 iron wire. The poles are 25 feet long with 5-inch tops, and are placed 25 to the mile. The wires are carried on brackets with small pony glass transposition insulators. Aside from the main line the system included connections with the sawmill, power house, railroad and wagon-road construction camps, gauging stations, and an adequate system at Arrowrock camps. In all, there were constructed 54 miles of telephone line which gave service to a maximum of 54 instruments.

Boise and Arrowrock Railroad.—The railroad is a standard-gauge steam road 17 miles long, built along the Boise River from Barberton, Idaho, the end of the Oregon Short Line branch, to Arrowrock. The maximum grade on the main line is 1.5 per cent and on spurs 3 per cent. The maximum curvature is 12°; all curves on grades are compensated. Sixty-pound rails of the A. S. C. E. section are carried on pine and fir ties. There are three timber bridges, aggregating 625 feet of span, and 2 miles of sidings. The equipment consisted of 3 locomotives, 2 passenger cars, 3 box cars, 4 flat cars, 36 gondola cars, and necessary gasoline and hand cars. Preliminary surveys were started in October, 1910. On February 4, 1911, authority was granted by the Secretary of the Interior to construct the road. Right of way was procured and construction started in January, 1911. The grading was let by contract, the contractor in turn subletting a portion to "station men." Track laying was started in July, 1911, and was completed on November 9, 1911, at which time all hauling of freight by wagon road was discontinued.

On December 11, 1911, the road was placed upon an operating basis, which continued without interruption until February 12, 1916. Dispatching was done by telephone, which proved very satisfactory. There were no wrecks or serious accidents, nor were there any serious injuries to either passengers or employees. During the period of operation there were carried 13,968,000 ton-miles of freight and 90,000 passengers in running 111,300 train miles. Of the freight carried, concrete aggregate was the largest single item. Materials for 427,650 cubic yards of concrete were handled from the gravel pit to Arrowrock, a distance of 13½ miles. A total of 25,052 cars were hauled, the maximum rate being 100 cars per day.

Wagon roads.—The building of the reservoir system made necessary the construction of wagon roads for the purpose of hauling materials and equipment and to replace old roads which would be flooded by filling the reservoir. In all there were built 24 miles of permanent roads and 5 miles of temporary roads. They were in the majority of cases built in sidehill cut, with a road width of from 7 to 9 feet, with maximum grades of 6 per cent. A few short pitches exceed this grade. At frequent intervals turnouts from 14 to 16 feet in width were provided. The first roads built were those over which freight was hauled from Barberton to Arrowrock prior to the completion of the railroad and over which lumber was hauled from the Government sawmill to Arrowrock. The first work done was started in January, 1911. Road work was carried on at various times until January, 1915, at which time the timber bridge crossing the river above the reservoir was finished, forming the connecting link in the roads above the flow line of the reservoir.

Power plant.—The entire construction plant at Arrowrock, with the exception of the steam shovel, dragline excavator, and dinkeys, was driven by electricity. To furnish the power necessary a hydroelectric power plant was constructed at the diversion dam. The plant is a 1,500 kilowatt, 3-unit plant, generating 3-phase, 60-cycle alternating current at 2,300 volts. The building is a reinforced concrete structure 62 feet by 44 feet in plan. The turbines are of the inward-flow axial discharge, open-flume type, with two runners mounted on a vertical shaft, designed for a normal effective head of 24 feet and for normal capacity at maximum efficiency of 725 horsepower each; speed, 180 revolutions per minute. Automatic oil-pressure governors control the wicket gates. Direct connected to the turbines are alternating-current generators of the field type, with normal capacity of 625 kilowatt volt amperes or 500 kilowatts each at 80 per cent power factor. Transformers are of the 3-phase, air-blast type, with normal capacity of 625 kilowatt volt amperes. A 32-foot span, 15-ton traveling crane commands the machinery side of the main floor at a height of 26 feet above it. Construction of the plant was begun in June, 1911, and was completed in April, 1912.

To June 1, 1916, the total output of the plant was 20,974,357 kilowatt hours; 11,704,307 kilowatt hours of this amount were used in connection with the construction of Arrowrock Dam and related features, 6,678,453 kilowatt hours were sold to a local power company, and 2,591,597 kilowatt hours were used on the Boise project in connection with the construction of drainage channels.

Transmission lines.—A duplicate transmission line was built from the power plant to Arrowrock, a distance of about 12 miles, and a single line to Barberton, 3 miles from the plant, where connection was made with the line owned by the local power company. White cedar poles, 35 feet long, with 8-inch tops, are set 250 feet apart, 6 feet in the ground; three poles on each curve are guyed. Each pole carries a 5-foot 8-inch cross arm 24 feet 6 inches from the ground and a short arm near the top. Two-part "Thomas" insulators are mounted upon the cross arms to form an equilateral triangle 60 inches on a side.

The conductors are hard drawn, 7-strand No. 3 copper. The current is transmitted at 22,000 volts to the transformer house at Arrowrock.

Construction of the transmission lines was started about the same time that the power house was begun; the lines were used for the first time on September 16, 1911. The operation of the line is conducted by telephone, the wires of which are carried on the transmission-line poles 5 feet below the power lines on oak brackets and "Thomas" porcelain insulators. Transposition of the wires is made at every other pole. The wire is No. 12 B. B. galvanized, protected at each end by 25,000 volts insulating transformers.

Sawmill.—To furnish lumber for the construction of the camp at Arrowrock a sawmill was built on Cottonwood Creek, 14 miles above Arrowrock in the Boise National Forest. A Curtis "Dixie O" sawmill, with 54-inch saw and top-saw rig with 36-inch saw, was installed. The plant also included a swing cut-off saw and a 3-saw gang edger. The plant was run by a 40 horsepower Nagle steam engine and two 30 horsepower boilers. In the timber 12 head of horses and a 7 by 10 American steam hoisting engine were used. The plant was operated from April, 1911, to September, 1913. The total output was 6,747,000 feet of lumber; the daily capacity was from 15 to 20 M. per eight-hour day.

Construction camp at Arrowrock.—The construction camp was located about one-fourth mile below the dam site and was built to accommodate about 900 men. The largest number of men employed on the storage unit in any one month was 1,059, but a part of these were at points other than Arrowrock.

The buildings were of a comparatively permanent nature. Special attention was given to sanitation and to providing the best possible camps and conveniences for laborers, including provision for their amusement and recreation.

The main camp consisted of 13 cottages, a dining room and kitchen for the engineers and office force, 3 dining rooms and a kitchen for the laborers and mechanics, office building, warehouse, cold-storage and artificial ice plant, general store and clubhouse, post office, schoolhouse, hospital, isolation hospital, guest house, dormitory for the engineers and office force, 2 dormitories for foremen and mechanics, 1 dormitory for skilled laborers, 1 bunk house for kitchen and dining-room forces, 9 bunk houses for common laborers, root cellar, bakery, central heating plant with public bath in connection, washhouse, stable, 2 general workshops, including carpenter and machine shops, 2 iron and steel sheds, electrical shop, cement-testing laboratory, pipe shop, oil house, powder house, cable house, boot house, compressor house, sand-cement plant, transformer house, mixing plants, crushing and screening plants, and other smaller buildings.

The camp was served by a very complete water and sewer system. Water was obtained from Deer Creek, about 1¼ miles above camp.

The cottages and transformer house were plastered buildings with stained exterior, constructed of 12-inch boards laid 10 inches to the weather, and roofed with "Cronolite roofing." Other buildings were not plastered. They were sheathed with 1-inch stuff and covered with either Cronolite or Neponset roofing. All roofs were covered with Cronolite. All buildings were electric lighted and the main buildings were steam heated.

Diversion works.—The flow in the Boise River at Arrowrock varies from a minimum of about 500 second-feet to a maximum of about 16,000 second-feet, with an extreme flood occasionally reaching 20,000 second-feet, and with a possibility once in 20 or 30 years of perhaps a 30,000 second-foot flood. After considerable discussion and investigation it was decided to provide diversion works to take care of about 20,000 second-feet.

As built the diversion works consisted of an upper cofferdam with a maximum height of 40 feet and a total length of about 200 feet; a diversion tunnel 30 feet wide and 25 feet high, the arched top having a 10-foot rise and with a length of 487 feet; and a lower cofferdam with a maximum height of 25 feet and a total length of 150 feet. The cofferdams were built of timber cribs filled with rock, gravel, and fine material sluiced in place. The faces were of solid timber construction with joints caulked with oakum. The bottom and sides of the tunnel were lined with concrete. The arched top was lined with 4-inch timbers spiked to 14 by 14 inch timber sets, which were at 5-foot centers.

A carefully constructed bell mouth at the upper end of the tunnel gave a very smooth entrance, and one at the outlet discharged the water into the river again with a minimum disturbance.

The tunnel was driven through granite. The method employed was to drive twin headings under the haunches of the arch, leaving a center pillar 6 to 8 feet thick. The pillar was then removed. The bench was taken out in two lifts. Sullivan drills (U. F. No. 2), with 3½-inch cylinders, were used exclusively. Work was started in August, 1911, and was completed in October, 1912. In December, 1914, when there was no longer any need for the diversion tunnel, it was filled with concrete for a length of 190 feet under the dam section.

Excavation for dam.—The estimated amount of excavation in the river bed was something over 230,000 cubic yards, not including the stripping of abutments. The excavation was removed in two sections. First, enough material was removed to allow the construction of a portion of the dam along the upstream side to a height sufficient to protect the work during the following flood period. The second step in the excavation was the removal of the material downstream from the constructed portion to the full width of the dam.

Although the steam-shovel outfit started to work on the north side of the river in February, 1912, actual river-bed excavation was not commenced until July 5 of that year, at which time the whole flow of the river was turned through the diversion tunnel.

The character of the material in the river bed was largely gravel and sand, with perhaps 5 to 10 per cent of bowlders exceeding two-man size. Inasmuch as concrete materials were not plentiful in the vicinity of the work, all excavated material which was suitable for concrete was stored for that use.

Two Lidgerwood 8 to 12 ton cableways, with spans of approximately 1,300 feet, covered the excavation to good advantage. A drag-line excavator, working in the pit between these cableways, loaded the material into the four 4-yard skips, and these were lifted and conveyed to the screening and crushing plant, where the material was separated into sand, gravel, and cobbles. These were stored in separate piles for future use. Two 10-ton, 80-foot boom, stiff-leg derricks located on the steep cliff along the river bed commanded portions of the excavation not reached by the drag-line excavator.

Considerable work was necessary to obtain a suitable foundation. On the south side of the river the lava cap was entirely removed in order that the dam might be founded upon the underlying granite. Over the entire foundation rock was removed to varying depths to obtain a foundation of excellent quality. Along the heel and toe of the dam and in the lower portion along the center keyways were excavated in the rock. The same drilling equipment was used that was used in the diversion tunnel. The excavation of the abutments was carried on just ahead of concreting and was completed in November, 1915.

Pumping plants were provided to handle as high as 50 second-feet of seepage into the excavated pit, but there was not a time during the period of river-bed excavation when an 8-inch pump could not have handled the water. The pumping units were mounted upon trucks which could be lifted out of the pit in case of flood.

Excavation for spillway.—The material moved was granite with a light overburden of earth. The rock was seamy and in portions of the trench conditions were favorable for slides. The largest slide of several which occurred contained about 25,000 cubic yards of rock. Along the uphill side of the excavation the depth of cut varied from about 80 feet to nearly 250 feet. Work was started in June, 1911, to get a toe hold on the steep sidehill slope. This was widened until there was room for the steam shovel to operate in. In October, 1912, the steam-shovel outfit, consisting of a 70-ton Atlantic shovel, two 18-ton dinkeys, and 4-yard dump cars, was moved to the spillway. Sullivan drills were used for heavy work and jap drills for trimming the slopes. The rough excavation was completed in December, 1913, after 14 months of continuous work, and the steam-shovel outfit was moved to the gravel pit. The slides which occurred after the steam shovel was moved were removed by Bagley grader and orange peel. The spillway excavation was completed in August, 1915.

Construction of the dam.—Concrete work on the dam commenced in November, 1912, and was completed in November, 1915. It was virtually built in three sections. The first section, as indicated previously, was built to protect the future work and consisted of a portion of the dam along the upstream face built to a height of about 40 feet above high water in the river, and of ample section to withstand the pressure of water against it for its full height. The second section completed the dam for its full width to the top of the first section. The third section completed the dam.

The best progress was made during the months of April, May, June, and July, 1914, when more than 200,000 cubic yards of concrete were placed, an average of more than 50,000 cubic yards per month. In June, 1914, 56,500 cubic yards were placed in 26 working days, an average of 2,170 cubic yards per day of two eight-hour shifts.

The material for the first and second sections—186,000 cubic yards—was obtained from the river-bed excavation. The remainder was hauled from the gravel pit over the railroad. Sand cement was used.

A sand-cement plant with a capacity of from 1,800 to 2,000 barrels of sand cement per 24 hours was erected at the dam site. This plant manufactured a total of 586,450 barrels of sand cement. The material excavated from the river bed was passed through a gravity screening plant. The oversize was crushed by a No. 5 Austin gyratory crusher. The concrete material obtained at the gravel pit was carried in 4-yard cars, hauled by 18-ton dinkeys, to a screening plant at the pit, where it was put through Austin rotary screens. At this plant there were six screens and two No. 5 Austin crushers.

The concrete-mixing plant for placing the first and second sections was a two-unit plant located on the lava cliff and in the dam section. The plant used for the final section was of three units and was located on the lava cliff just below the dam. No. 14, 1-cubic-yard Smith mixers were used in both plants. The sand, gravel, and cobbles were measured out through air-operated measuring boxes; the sand cement was weighed out.

Most of the concrete was placed in the dam by means of the Crowe concrete cableway system. A 2-cubic-yard conveying bucket with automatic dump carried the concrete from the plant to a distributing hopper carried on the main cable. The distributing hopper could be moved to any position along the cable and carried a 40-foot swivel chute which could be swung through 360°. This made it possible to cover a strip 80 feet wide along the line of the cableway. Above the point where it was practicable to place concrete by this system, 65 feet below the finished top, a trestle system was resorted to. The main Lidgerwood cableways carried the concrete from the mixing plant to each end of the dam, where it was received by 2-cubic-yard electric rocker dump cars which conveyed it to place.

The outlet gates and valves were installed by use of the cableways and a stiff-leg derrick set on top of the dam; a traveling crane for handling the balanced valves and for raking trash racks operated on top of the dam.

The principal quantities in the dam are 322,390 cubic yards of excavation, 585,165 cubic yards of concrete, 603,020 pounds of reinforcing steel, 2,672,300 pounds of gates, machinery and structural steel, 10,490 linear feet of grout and drainage holes in bedrock, 24,540 linear feet of drainage conduits in concrete, 1,067 linear feet of tile drain, 2,182 linear feet of inspection and operating galleries, 2,821 linear feet of outlet conduits, and 4,168 linear feet of contraction joints.

Construction of spillway.—Concrete work on the spillway was started in September, 1914, and finished in October, 1915. The concrete was all obtained from the second mixing plant and was transported by one of the Lidgerwood cableways to a dumping hopper, thence by gravity chute to cars or concrete cableway. That for the lower end of the trench was handled in cars hauled by a 7-ton dinkey. The floor of this portion of the trench was laid direct from dump cars, and a traveling derrick handled dump buckets for placing concrete in the side lining. The upper end of the trench and the spillway weir were covered by a concrete cableway similar to those used on the dam. All the spillway concrete was reinforced. The trench lining was anchored to the rock by anchor bars to which the reinforcing steel was fastened.

The movable crest gates were conveyed from the railroad cars to the spillway over the Lidgerwood cableways and assembled in place.

The principal quantities in the spillway are 359,100 cubic yards of excavation, 1,300 cubic yards of back fill, 25,564 cubic yards of concrete, 708,690 pounds of reinforcing steel, 641,770 pounds of gates, machinery and structural steel, 5,030 linear feet of drains, and 50,200 pounds of structural steel in highway bridge.

Construction of log conveyor.—Construction of the log conveyor was started in March, 1915, and was finished in November, 1915, with the exception of placing a small amount of machinery, which was completed in the early part of 1916. Concrete was conveyed from the mixing plant to the top of the dam at the south end, where the log conveyor is located. From here it was carried by car to gravity chutes, which conveyed the concrete to place.

The principal quantities in the log conveyor are 8,265 cubic yards of excavation, 2,134 cubic yards of concrete, 84,060 pounds of reinforcing steel, 300,390 pounds of machinery and structural steel, and 200 linear feet of tunnel.

Operation of dam.—The dam was completed to a sufficient height in the spring of 1915 to allow the storage of 180,000 acre-feet of water in the reservoir. The records show the run-off for 1915 to be the lowest on record. In anticipation of this the work on the dam was rushed to provide an adequate storage of water for use on the project.

The reservoir was filled for the first time to the crest of the concrete weir on June 17, 1916, after having been used for regulating the usual spring freshets. The outlet works through the dam have been used and have given no trouble whatever. The movable crest gates on the spillway weir have also been operated successfully.

The dam itself has proven its excellence in every respect under all heads. The leakage and seepage is negligible, amounting to only 0.39 second-foot with a full reservoir.

CONSTRUCTION DURING FISCAL YEAR.

Storage unit (Arrowrock Dam and related features).—The Boise power plant was operated throughout the year. The total output of the plant for the fiscal year was 2,805,410 kilowatt hours, of which 80.7 per cent was sold to the Electric Investment Co., including the amount exchanged on account of the drainage-construction work on the project.

The Boise & Arrowrock Railroad was upon an operating basis until February 12, at which time all service was discontinued with the exception of an occasional train for transporting equipment and materials from Arrowrock.

The dam was completed in November, although it was dedicated on October 4. One thousand eight hundred and twenty-five cubic yards of concrete were placed in the dam during the fiscal year. The dam was operated to deliver the irrigation water stored in the spring of 1915, and when the water in the reservoir was sufficiently lowered the two remaining balanced valves were installed. Water was stored again during the spring of 1916, and the reservoir was filled for the first time on June 17, 1916, to the elevation of the crest of the concrete weir.

The spillway was completed in October, 1915; 4,070 cubic yards of excavation were removed and 3,084 cubic yards of reinforced concrete were placed in the lining and weir. The movable crest was installed, which required the placing of 642,000 pounds of structural steel and cast iron.

The log conveyor was completed during the year; 8,265 cubic yards of excavation were removed and 2,134 cubic yards of concrete, a large percentage of which is reinforced, were placed. The machinery and superstructure over the log deck required the placing of 231,990 pounds of structural steel and cast iron.

The lower end of the conveyor is carried through 200 linear feet of tunnel which was constructed during the early part of the year.

The sand-cement plant ceased operations on July 9. The output for the year was 1,210 barrels of sand cement. The plant was dismantled and equipment stored.

The gravel pit and screening plant at the diversion dam were not operated.

All plant has been dismantled and shipped to the diversion dam for storage, pending sale or transfer. Considerable equipment has been disposed of through sale or transfer to other projects.

The construction camp has been removed. The buildings were sold to individuals who wrecked them.

Distribution unit, Main Canal.—The only construction done on the Main Canal during the year was on the section from Indian Creek to the Deer Flat Reservoir, where 47,742 square yards of paving were placed on the inner slopes to prevent erosion due to velocity and wave action.

Deer Flat Reservoir.—The wing walls of the approach to the outlet gates at the lower embankment were raised to prevent gravel sliding in from the embankment, and the channel leading to these gates was enlarged.

Lateral system.—The principal work on the lateral system was in the nature of reconstruction or replacement of timber work with concrete and masonry.

During the fiscal year 1916 approximately 700 small timber drops, checks, weirs, and chutes were replaced in this manner. Also three large concrete chutes were installed to replace a series of timber drops on the Frohman and Lizard wasteways. A large concrete flume, capacity 880 second-feet, was installed to replace a timber structure on the Mora Canal. Approximately 2 miles of concrete lining were placed on the Deer Flat Lowline and Mora Canals, and also several fills on the laterals were concrete-lined.

The first 7 miles of the Deer Flat Lowline Canal were widened to increase the capacity from 800 to 1,000 second-feet. Some lateral extension work was done; and approximately 500 small timber structures, mostly farm tap boxes and weirs, were installed for new lands.

SEEPAGE AND DRAINAGE.

An approximation of the seeped areas is given herewith in tabular form, based on a water plane from 0 to 6 feet below the ground surface. In general these areas have increased slowly during the year, but several isolated small areas have become dangerously affected:

Estimate of seeped areas.

Name of area.	Acreage previously reclaimed.	Acreage reclaimed, 1916.	Estimated acreage still seeped.
Pioneer Irrigation District	6,800	2,500	1,200
Nampa and Meridian District		1,600	4,600
Fargo Basin	700		
Miscellaneous	250		1,100
Total	7,750	4,100	6,900

The drainage construction now under way is expected to reclaim all the seeped areas noted above with the exception of the 1,100 acres in miscellaneous localities, for which no definite plans are formed.

The construction of open drains proceeded throughout the year in the Pioneer Irrigation District and in the Nampa and Meridian Irrigation District. The work in the former district will be approximately 90 per cent complete at the end of the fiscal year, and that in the latter approximately 40 per cent complete.

Prior to January 1 two electric drag-line excavators were employed, and since that date four have been employed. These machines are worked three 8-hour shifts per day, and their output is recorded below:

Progress of excavation.

	Fiscal year [1] 1916.		Prior to fiscal year 1916.		Total.	
	Miles.	Yardage.	Miles.	Yardage.	Miles.	Yardage.
Pioneer Irrigation District	22.9	1,067,481	50.6	1,816,770	73.5	2,884,251
Nampa and Meridian District	14.2	602,456			14.2	602,456
Fargo Basin			5.6	275,644	5.6	275,644
Drain from upper embankment			4.1	103,017	4.1	103,017
Total	37.1	1,669,967	60.3	2,195,431	97.4	3,865,368

[1] To June 1, 1916.

ECONOMIES OF GOVERNMENT WORK.

Boise & Arrowrock Railroad.—To facilitate the hauling of materials and equipment for the construction of the dam and appurtenant structures a standard-gauge steam railroad was built by the Government from Barberton to Arrowrock, a dstance of 17 miles.

The road was built in 1911 and was placed upon an operating basis on December 11 of that year. It cost a total of $392,840, or $20,676 per mile of track.

The equipment, consisting of 3 locomotives, 2 passenger cars, 3 box cars, 4 flat cars, 36 gondola cars, 3 gasoline speeders, 3 hand cars, and 3 velocipedes, cost the Government $39,715.97 at Barberton, Idaho.

The railroad operated continuously until February 12, 1916, at which time operations were discontinued except for occasional trains out of Arrowrock hauling equipment.

A summary of results to December 31, 1915, shows the following:

Freight earnings	$243, 105. 53
Passenger earnings	57, 381. 33
Miscellaneous earnings	4, 621. 41
Total	305, 108. 27
Operating cost	237, 646. 19
Total gain	67, 462 .08
Freight, ton-miles	13, 967, 264
Number of passengers carried	89, 639
Total train mileage	111, 229
Average operating cost per train-mile	$2. 14
Operatnig cost per ton-mile	$0. 017
Cost per ton-mile (including total cost of railroad)	$0. 045

Prior to the construction of the railroad the cost of hauling freight by wagon road to the dam site was $8 per ton, or approximately 17 cents per ton-mile.

Sand cement plant at Arrowrock Dam.—In the construction of Arrowrock Dam and Spillway approximately 610,600 cubic yards of concrete were placed. The cost of cement entering into this great amount of concrete was a very important item and offered a great field for investigation, since a small saving in the unit cost of cement would very materially reduce the final cost of the structure.

Based upon tests made with sand cement in which the blending material was granite from the excavation of the spillway channel, upon investigations of the actual use of sand cement in structures which had been in service several years, and upon estimates of cost of the installation and operation of the necessary equipment, it was decided to use sand cement.

A sand cement plant having a capacity of 1,800 to 2,000 barrels per 24 hours was erected at Arrowrock at an approximate cost of $76,500. This plant consisted of a rock crusher, sand rolls, drier, ball mill, proportioning machine, four tube mills, the necessary conveying equipment, and storage bins with a capacity of about 9,000 barrels of sand cement.

The crushed granite and Portland cement were weighed out in a double compartment scale hopper and dumped into conveyors, which carried them to the tube mills. In the tube mills they were ground together to form "sand cement." The product of the tube mills was required to pass 90 per cent through the 200-mesh screen and to contain 45 per cent by weight of the blending material from the spillway excavation and 55 per cent by weight of Portland cement.

The product, sand cement, was conveyed from the tube mills to the storage bins. From the bins it was conveyed to the mixing plant through a pneumatic conveyor.

A total of 586,450 barrels of sand cement was manufactured at Arrowrock. The average output per tube-mill hour was 17.8 barrels. The average cost per barrel was $1.35, including the Government freight rate on Portland cement.

A definite statement of the saving effected by the use of sand cement in place of straight Portland cement can not be made, since conditions governing handling and usage would in all probability not be comparable with those under which sand cement was used. However, for the sake of comparison, assume that an equal amount of Portland cement was used to replace the sand cement and that the cost of handling was the same in each case. A portion of the cost of the testing laboratory was chargeable to sand cement—assume one-half.

Portland cement:		
586,450 barrels, at $1.89		$1,108,390.50
Sand cement:		
586,450 barrels, at $1.35	$791,607.50	
One-half laboratory expense	7,500.00	
		799,107.50
Approximate saving effected		309,283.00

The costs include all items of expense except general expense, which amounts to about 8 per cent.

Boise power plant.—Investigations and estimates showed that the construction of Arrowrock Dam could be accomplished more economically and with greater convenience by using electric power rather than steam. Upon the recommendation of a board of engineers a 1,500 kilowatt, 3-unit, hydroelectric power house with 80 per cent power factor, together with the necessary transmission lines and substations, was built. In considering the advisability of building the plant considerable weight was given to the fact that it would be a valuable asset to the project after the completion of the construction work at Arrowrock Dam.

The current is 3-phase, 60-cycle, alternating, generated at 2,300 volts and transmitted at 22,000 volts.

Construction of the plant was begun in June, 1911, and was completed during April, 1912, at a total cost of $250,000, including transmission lines and substations. Although the power house was not placed upon an operating basis until May 12, 1912, power purchased from the local power company was carried to Arrowrock over the completed transmission line for the first time on September 16, 1911.

Through the provisions of a contract, to which the Government and the local power company are parties, use of power has been made possible both by exchange and by sale.

Following is a statement showing a summary of the results of operating the power plant to June 1, 1916:

Item.	Kilowatt hours.	Per cent of total output.
Power delivered for work in connection with Arrowrock Dam	11,704,307	55.8
Power sold to local power company	6,678,453	31.8
Power delivered to local power company in exchange for that delivered by them to drainage work on Boise project	2,591,597	12.4
Total output of power house	20,974,357	100.0
Power bought from local power company since Government plant was put in operation	34,380	
Cost of generating power, including all items of expense per kilowatt hour, 0.446 cent.		

The profit derived from the operation of the plant to June 1, 1916, through sales and exchange was approximately $35,000. No credit accrues from the delivery of power for the construction of Arrowrock Dam since that power was delivered at cost.

Aside from the superior convenience of electric power, as was demonstrated at Arrowrock and other large construction undertakings of the service, an important saving was effected in actual outlay for power by means of this plant. Assuming that the most favorable commercial power rates of 1 cent, three-fourths cent, and one-half cent per kilowatt hour on a sliding scale could have been obtained, the construction power bill would have amounted to approximately $94,000; whereas through the Government plant the same amount of power actually cost $52,000, making a net saving of $42,000.

To date the plant carries a depreciation charge of $24,903, which is included in the unit cost of operation of 0.446 cent per kilowatt hour.

Upon completion of Arrowrock Dam construction this power plant was advertised for lease, and under proposals opened February 7, 1916, a contract was entered into on May 1, 1916, with the Electric Investment Co. for taking over the operation of the plant on July 1, 1916. Reservation was made of about 25 per cent of the electrical output of the plant at substantially the cost of production for use in project drainage work and in operating the Arrowrock Dam controlling devices. For the balance of the plant output the company under the contract agrees to pay the net sum of $11,000 annually into project revenues.

BOARD REPORTS.

Waldvogel subdivision, Boise project; February 23, 1911; personnel: A. P. Davis, chief engineer; F. E. Weymouth, supervising engineer; F. W. Hanna, project engineer.

Railroad from Boise to Arrowrock, February 25, 1911; personnel: A. P. Davis, chief engineer; F. E. Weymouth, supervising engineer; Charles H. Paul, engineer; B. E. Stoutemyer, examiner.

Arrowrock Dam, September 9, 1911; personnel: A. P. Davis, chief engineer; A. J. Wiley, consulting engineer; F. E. Weymouth, supervising engineer; Charles H. Paul, construction engineer.

Arrowrock Dam, January 28, 1912; personnel: A. P. Davis, chief engineer; A. J. Wiley, consulting engineer; F. E. Weymouth, supervising engineer; Charles H. Paul, construction engineer.

Arrowrock Dam, power development, February 13, 1913; personnel: A. P. Davis, chief engineer; A. J. Wiley, consulting engineer; D. C. Henny, consulting engineer; O. H. Ensign, chief electrical engineer; F. E. Weymouth, supervising engineer; Charles H. Paul, construction engineer.

Drainage in vicinity of Caldwell and Nampa, August 30, 1913; personnel: D. C. Henny, consulting engineer; F. E. Weymouth, supervising engineer; George H. Bliss, project engineer.

Regarding various matters in connection with construction of Arrowrock Dam, February 11, 1914; personnel: A. P. Davis, chief engineer; A. J. Wiley, consulting engineer; F. E. Weymouth, supervising engineer; Charles H. Paul, construction engineer; James Munn, superintendent of construction; Alfred B. Mayhew, engineer.

Re Nampa-Meridian Irrigation District contract and drainage, February 15, 1914; personnel: A. P. Davis, chief engineer; D. C. Henny, consulting engineer; F. E. Weymouth, supervising engineer; George H. Bliss, project manager; J. L. Burkholder, assistant engineer.

Nampa-Meridian Irrigation District contract and drainage (supplemental), February 17, 1914; personnel: D. C. Henny, consulting engineer; F. E. Weymouth, supervising engineer; George H. Bliss, project manager; J. L. Burkholder, assistant engineer.

OPERATION AND MAINTENANCE.

The right of the United States to divert water from the natural flow of the Boise River terminated for the season of 1915 on June 29, prior to which date several cuts were made by order of the State, the first of which took place on June 12, on and after which date it was necessary to draw on Arrowrock Reservoir in order to maintain the necessary discharge into the Main Canal.

Storage capacity in Arrowrock Reservoir was available for the first time and approximately 180,000 acre-feet of water were stored by June 12, after which the demand upon the reservoir gradually diminished the supply until the close of the irrigation season, when 4,612 acre-feet remained. The availability of this storage proved most opportune, for the year was a record breaker from the viewpoint of light run-off from the Boise River watershed, and extreme losses to users on the Government project were not only averted, but similar losses were saved to other projects under the Boise River through the sale to them under special contracts of approximately 26,000 acre-feet of storage water.

Water was delivered to lands under the project at the rate of 40 cents an acre-foot prior to August 1 and at the rate of 60 cents an acre-foot on and after that date, or for flood water and storage water, respectively. The revenues from this source amounted to approximately $100,000, and resulted from the delivery of approximately 230,000 acre-feet of water to 1,727 farms, containing an irrigated area of 76,705 acres. The average amount of water used per acre was 2.81 acre-feet, at an average cost of $1.39 per acre.

Under contract with the New York Canal Co. (Ltd.) 20,422 acres of land, comprising 405 farms, were watered through the Government canal system, the water being derived from the vested right of that company.

Under contract with the Idaho-Iowa Lateral & Reservoir Co. the reservoirs of that company were filled during the year through the Government canal system.

The maximum storage for Deer Flat Reservoir for the year was 121,542 acre-feet. The total storage for the season was 252,419 acre-feet. At the close of the irrigation season 12,374 acre-feet of storage remained.

A total of 97,127 acres of land was irrigated from the project system during the year, including the 20,422 acres of New York lands previously mentioned. Of this total, 34,009 acres were watered from the system below Deer Flat Reservoir and the remainder from the system above.

Maintenance.—The usual amount and character of maintenance work has been done during the year, consisting of the cleaning of laterals and the repairing and replacement of wooden structures. Considerable paving and riprapping with stone and sagebrush were done to prevent erosion of canal banks. Only one break of importance was experienced; this was on the Mora Canal where it crossed Indian Creek in a timber flume, the fill at the inlet of the flume washing out. It required about three days to make the repair, and as it was in the hot part of the season some damage resulted, though not serious.

Historical review, Boise project, Idaho.

Item.	1911	1912	1913	1914	1915	1916
Acreage to which the Service was prepared to furnish water	120,000	200,000	207,000	207,000	207,000	230,000
Acreage irrigated	45,575	61,725	76,265	83,590	97,127	112,000
Miles of canals operated	624	966	969	971	973	980
Water diverted, acre-feet	337,963	370,056	495,470	495,665	542,102	(1)
Water delivered to land per acre of land irrigated, acre-feet	1.79	1.93	2.38	2.62	2.81	(1)

[1] Not yet determined.

SETTLEMENT.

This subject has received a considerable impetus through the recent sale of approximately 9,000 irrigable acres of State land. A large part of this land is now settled upon and in cultivation for the first time. Generally speaking, it is in the hands of a class of farmers who possess the knowledge and the means necessary to make farming a success. This land was sold at public auction and at very reasonable prices, payment therefor to be made in 40 annual installments, with a 6 per cent interest rate on deferred payments.

Impetus was also given to settlement of lands above Deer Flat Reservoir by certain knowledge that Arrowrock storage insured a full season's supply of water for these lands.

Settlement data, Boise project.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	2,391	2,450	2,600	2,690	3,926
Population	7,000	7,500	8,000	8,600	12,560
Number of irrigated farms	1,223	1,575	1,771	1,908	2,450
Operated by owners or managers	1,050	1,350	1,521	1,358	1,590
Operated by tenants	173	225	250	550	860
Population	3,669	4,275	5,313	6,143	7,520
Number of towns	9	10	10	10	10
Population	30,000	30,350	30,400	30,500	34,350
Total population in towns and on farms	37,000	37,850	38,400	39,100	46,910
Number of public schools	16	18	20	22	22
Number of churches	40	45	50	52	52
Number of banks	10	11	11	13	15
Total capital stock	(1)	(1)	$1,505,000	$1,545,900	$1,750,000
Total amount of deposits	(1)	(1)	$7,326,480	$8,424,300	$9,000,000
Total number of depositors	(1)	(1)	27,038	[2] 23,772	24,850
Total number of relinquishments	(1)	15	10	6	18

[1] No record.

[2] Estimated; some banks refuse to give number of depositors.

PRINCIPAL CROPS.

The usual variety of crops was grown on the project during 1915. The principal crops were alfalfa, barley, clover hay, clover seed, Indian corn, oats, potatoes, and wheat. Alfalfa covered the largest area, amounting to 22,259 acres; this was an increase over the previous year of 4,131 acres. Wheat came next with 17,504 acres, or an increase of 6,446 acres. Increased acreages were also shown for barley, oats, and potatoes, although proportionately not so great; clover hay, clover seed, and Indian corn showed decreases, due in some measure to the increase in wheat cultivation, which was stimulated by good returns the previous year.

Crop report, Boise project, Idaho, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa hay	22,259	Ton	85,080	3.82	$6.00	$510,480	$22.93
Alfalfa seed	246	Bushel	786.5	3.19	9.00	7,079	28.71
Apples	504	Pound	542,093	1,075.6	.02	10,842	21.51
Barley	2,776	Bushel	72,969	26.28	.53	38,674	13.93
Beans	172	...do	2,143.83	12.46	3.00	6,431	37.39
Beets, sugar	3	Ton	16	5.8	5.00	80	29.09
Clover, hay	4,561	...do	6,743	1.48	6.00	40,458	8.87
Clover seed	4,504	Bushel	16,044	3.56	10.50	168,462	37.40
Corn, Indian	6,765	...do	197,991	29.27	.60	118,795	17.56
Corn, sorghum	188	Gallon	9,251	49.11	.50	4,626	24.56
Corn, fodder	279	Ton	1,717.75	6.15	7.00	12,024	43.02
Fruits, small	71	Pound	84,790.5	1,200.66	.05	4,240	60.03
Garden	734	....	....	....	....	28,846	39.30
Hay, except above	331	Ton	475.25	1.44	6.00	2,851	8.60
Millet seed	89	Bushel	364	4.11	2.00	728	8.23
Oats	6,974	...do	158,472	22.72	.40	63,389	9.09
Onions	7	...do	308.33	45.68	.80	247	36.54
Pasture	5,239	....	....	....	....	53,366	10.19
Peaches	133	Pound	204,240	1,541.43	.01	2,042	15.41
Peas	77	Bushel	525.75	6.83	1.75	920	11.95
Prunes	28	Pound	223,700	7,918.58	.0075	1,678	59.39
Potatoes, common	1,337	Bushel	219,460	164.14	.60	131,676	98.49
Potatoes, sweet	62	...do	1,335	21.49	2.50	3,337	53.73
Rye	177	...do	1,916.5	10.79	.60	1,150	6.47
Wheat	17,504	...do	418,504	23.91	.75	313,878	17.93
White-clover seed	26	...do	46	1.77	12.50	575	22.12
Less duplicated areas	5,228	....	....	....	....	....	....
Total cropped acreage	69,818	Total and average				1,526,873	21.87
Irrigated, no crop:							
Nonbearing orchard	5,786						
Young alfalfa	4,369						
Young clover	2,842						
Ground fall plowed	126						
Miscellaneous	139						
Less duplicated areas	6,374						
Total irrigated acreage	76,705						

Areas.	Acres.	Farms.	Per cent of project.
Total irrigable area farms reported	99,973.19	1,727	[1] 43.46
Total irrigated area farms reported:			
Under water-right applications	76,705	1,727	33.35
Under rental contracts	76,705	1,727	33.35
Total cropped area farms reported	69,818	1,727	30.35

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[1] Based on 230,000 acres, including vested water-right lands for which crop statistics were not collected, as follows: 34,000 acres in Pioneer irrigation district, 25,000 acres in Nampa and Meridian irrigation district, and 21,000 acres covered by water of the New York Canal Co. (Ltd.), or a total of 80,000 acres.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 703.]

Feature costs of Boise project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys:		
Distribution unit	$118,960.82	
Storage unit	8,781.36	$127,742.18
Storage system:		
Deer Flat Reservoir	957,613.67	
Arrowrock Reservoir	4,772,723.17	5,730,336.84
Canal system: Main South Side Canal		2,025,167.28
Lateral system:		
From Main Canal	1,348,012.71	
From Deer Flat Reservoir	1,106,926.10	
Penitentiary lateral	23,625.00	2,478,563.81
Drainage system:		
Pioneer district	257,187.92	
Nampa-Meridian district	97,496.19	
Cooperative	48,895.73	
Fargo Basin	37,494.38	
From Deer Flat	31,796.98	
Miscellaneous	7,288.17	480,159.37
Power system, Boise power plant		195,305.27
Farm units		46,899.80
Permanent improvements and lands:		
Distribution unit	52,979.54	
Storage unit	79,054.88	132,034.42
Telephone system:		
Distribution unit	34,377.50	
Storage unit	9,675.20	44,052.70
Operation and maintenance during construction:		
Irrigating system	747,916.72	
Commercial power	27,540.14	775,456.86
Plant accounts:		
Storage unit	22,861.02	
Distribution unit and operation and maintenance	27,552.37	
Drainage construction	40,558.98	90,972.37
Gross cost of construction of project to June 30, 1916		12,126,690.90
Less revenues earned during construction period:		
Rental of buildings	25,807.32	
Rental of farming and grazing lands	12,532.61	
Rentals, power and light	50,312.46	
Rentals of irrigation water	378,721.99	
Contractors, freight refunds	13,082.53	
Forfeitures by defaulting bidders and contractors	24,197.92	
Other revenues, unclassified	14,195.67	
Profit on mess-house operations	57,494.07	
Profit on mercantile store operations	45,000.06	
Loss on hospital operations (contra)	[1] 6,248.26	
Other profits on operations, unclassified	13,046.71	628,143.08
Net cost of construction of project to June 30, 1916		11,498,547.82

[1] Deduct.

Estimated cost of contemplated work, Boise project, fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examinations and surveys		$10,000
Storage system: Spillway at Arrowrock		5,000
Canal system: Main canals, paving		5,000
Lateral system:		
Laterals and sublaterals	$139,000	
Flumes	2,000	
Drops, chutes, and checks	10,000	
Wasteways	6,000	
		157,000
Drainage system:		
Preliminary and general work	7,000	
Open drains	215,000	
Flumes	6,000	
Bridges	14,000	
Culverts and underdrains	8,000	
		250,000
Farm units		2,000
Permanent improvements and land:		
Buildings	1,000	
Real estate	3,000	
		4,000
Telephone system: Telephone lines		2,000
Operation and maintenance during construction:		
Operation	92,000	
Maintenance	108,000	
		200,000
Messes		3,700
Mercantile stores		1,700
Hospitals		9,600
Total		650,000

IDAHO, MINIDOKA PROJECT.

Barry Dibble, project manager, Rupert, Idaho.

LOCATION.

Counties: Minidoka and Cassia, Idaho; Jackson Lake Reservoir, Uinta, Wyo.

Townships: 8 to 11 S., Rs. 22 to 25 E., Boise meridian; Jackson Lake Reservoir, Tps. 44 to 46 N., Rs. 114 to 116 W., sixth principal meridian, Wyoming.

Railroads: Oregon Short Line; Salt Lake and Idaho.

Railroad stations and estimated population January 1, 1916: Rupert, 1,500; Heyburn, 300; Burley, 2,500; Ashton, 600; Paul, 100; Marshfield, 50; Minidoka, 150; and Acequia.

WATER SUPPLY.

Source of water supply: Snake River, supplemented by storage.

Area of drainage basin: 22,600 square miles above diversion dam.

Annual run-off in acre-feet of Snake River at Montgomery's and Howell's Ferries and Neeley (16,000 square miles), 1896 to 1915; Maximum, 8,230,000; minimum, 3,827,000; mean, 6,276,600. South Fork of Snake River at Moran, Wyo. (980 square miles), 1904 to 1915: Maximum, 1,530,000; minimum, 727,410; mean, 1,155,700.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916, 120,300 acres.

Area under water-right applications and rental contracts, season of 1916, 109,689 acres.

Length of irrigating season: From April 1 to October 31, 214 days.

Average elevation of irrigable area: 4,225 feet above sea level.

Rainfall on irrigable area: 10¾ years, average 12.46 inches; 1915, 10.76 inches.

Range of temperature on irrigable area: —15° to 100° F.

Character of soil of irrigable area: On north side of river, sand and sandy loam predominate; about one-third of the area is clay loam. On south side of river, the soil is a disintegrated lava ash.

Principal products: Alfalfa, grasses, rye, wheat, oats, sugar beets, potatoes, fruits.

Principal markets: Pocatello, Idaho; Salt Lake, Utah; Butte and Helena, Mont.

LANDS OPENED FOR IRRIGATION.

Dates of public notices and orders relating thereto (gravity unit): Public notices—March 9, 1907; November 23, 1908; February 11, March 30, 1909; February 7, March 22, June 10, October 13, November 3 and 25, 1910; January 23, December 30, 1911; March 21, 1912; June 23, 1913; September 24, 1914; February 27, March 20, 1915; March 4, May 4, May 27, June 10, and June 22, 1916. Orders—July 19, December 10, 1907; July 9, 1908; December 27, 1910; March 18 and 31, May 4, June 8, 1911; February 26, March 19 and 25, July 21, 1913; January 19, March 26 and 31, 1914; March 8, 1915; April 7, June 26, 1916. (South side pumping unit): Public notices—November 3, 1915; May 25, 1916; Orders—March 24, 1911; March 19, May 13, October 10, 1912; March 25, 1913; March 23, 1914; March 1, 1915.

Location of lands opened: Tps. 8 to 11 S., Rs. 22 to 25 E., Boise meridian.

Present status of irrigable lands opened: 93,823 acres entered subject to the reclamation act, of which 63,686 acres are on the gravity unit and 30,137 acres on the pumping unit, 1,806 acres open to entry on the gravity unit; 22,147 acres of State land, being 5,273 acres on the gravity unit and 16,874 acres on the pumping unit; 1,666 acres of private land, of which 217 acres are on the gravity unit and 1,449 acres on the pumping unit.

Annual operation and maintenance charge is based on the amount of water used. For 1916 the gravity unit is divided into three zones, which are entitled, respectively, to the minimum of 2, 3, and 6 acre-feet of water for 75 cents. Water in excess of these amounts shall be charged for at the rate of 15 cents per acre-foot. On the pumping unit the rate is $1 for the first acre-foot and 40 cents per acre-foot for excess water. About 38,000 acres in the south side pumping unit and 2,800 acres in the highland pumping systems of the gravity unit were irrigated in 1915 on a rental basis.

CHRONOLOGICAL SUMMARY.

First surveys with reference to storage possibilities in 1902.
Reconnoissance and preliminary surveys for main project begun March, 1903.
Construction recommended by board of engineers March 21, 1904.
Construction authorized by Secretary April 23, 1904.
Minidoka Dam completed September, 1906.
Temporary dam on the Moran site, Jackson Lake, completed in 1907.
First irrigation by Reclamation Service season of 1907.
Jackson Lake Dam completed November 25, 1911.
Contract for enlargement of Jackson Lake Reservoir entered into February 25, 1913.
Gravity unit, 98.2 per cent completed June 30, 1916, including drainage.
South side pumping unit, 97.2 per cent completed June 30, 1916.
Commercial unit, 65.4 per cent completed June 30, 1916.
Entire project, 97.1 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Minidoka project provides for the diversion of the waters of the Snake River by a combined storage, diversion, and power dam about 6 miles south of Minidoka, Idaho, into two canal systems, one on either side of the river, watering lands in the vicinity of Acequia, Rupert, Heyburn, and Burley, Idaho. Power developed at the dam is utilized primarily for pumping water from the canals to irrigate high lands, but also for pumping for drainage purposes and for furnishing heat, light, and current for commercial use to the towns on the project and the farms adjacent to them. The United States claims all waste, seepage, spring, and percolating water arising within the project, and proposes to use such water in connection therewith. Storage for the project is provided mainly by a reservoir constructed in the upper drainage basin of Snake River, at Jackson Lake, Wyo. This is supplemented by the reservoir formed by the Minidoka Dam and known as Lake Walcott. Jackson Lake Dam, as originally planned, and Minidoka Dam are completed. Jackson Lake Dam is now being raised 17 feet, which will make the capacity of the lake about 790,000 acre-feet. The irrigation system for the gravity unit and the south side pumping unit and the drainage system for the gravity canals are under construction.

SUMMARY OF GENERAL DATA FOR MINIDOKA PROJECT TO JUNE 30, 1916.

Areas:		
Irrigable acreage when project is complete		120,300
Public land entered June 30, 1916	93,823	
Public land open to entry June 30, 1916	1,806	
Public land withdrawn June 30, 1916	858	
State land June 30, 1916	22,147	
Private land June 30, 1916	1,666	
Acreage service could have supplied season of 1915		120,000
Estimated acreage service can supply July 1, 1917		120,333
Acreage actually irrigated season of 1915		83,562
Acreage cropped under irrigation season of 1915		77,008
Crops:		
Value of irrigated crops season of 1915		$1,725,515.00
Value of irrigated crops per acre cropped		$22.41

Finances:		
Estimated cost of completed project		$5,921,000.00
Total construction cost to June 30, 1916		$5,747,444.20
Per cent complete June 30, 1916		97.1
Appropriation for fiscal year 1917, total		$302,000.00
Allotment for construction fiscal year 1917		$62,600.00
Estimated per cent complete June 30, 1917		98.5
Announced construction charges per acre		$22, $30, $40, $56.50, $57.50
Appropriation, fiscal year 1916		$410,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation:		
Disbursements	$187,841.90	
Transfers	15,834.56	
	203,676.46	
Registered liabilities chargeable to 1916 appropriation	40,299.81	
		243,976.27
Unencumbered balance July 1, 1916		166,023.73
Repayments:		
Construction charges—		
Accrued to June 30, 1916		513,262.84
Collected to June 30, 1916		504,051.53
Uncollected June 30, 1916		9,211.31
Operation and maintenance charges (public notice)—		
Accrued to June 30, 1916		406,558.33
Collected to June 30, 1916		388,866.78
Uncollected June 30, 1916		17,691.55
Water rental charges—		
Accrued to June 30, 1916		210,967.16
Collected to June 30, 1916		135,575.16
Uncollected June 30, 1916		75,392.00
Power earnings—		
Accrued to June 30, 1916		86,466.36
Collected to June 30, 1916		84,413.84
Uncollected June 30, 1916		2,052.52
Drainage:		
Estimated acreage damaged by seepage to June 30, 1916		543
Miles of drains built to June 30, 1916—open		108
Estimated acreage protected by drains built to June 30, 1916		63,933
Estimated acreage to be protected by authorized system		64,000
Expended to June 30, 1916, for drainage works, completed and uncompleted		$712,474.76

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

MINIDOKA DAM AND SPILLWAY AND RELATED WORK.

Proposals for the construction of Minidoka Dam, spillway, gates, and a part of the North Side Canal were opened on July 2, 1904, and a contract for the work was executed on September 17, 1904. The construction work was begun in October, 1904, and completed in September, 1906, but the testing of gates and structures was not completed until February, 1907.

The Minidoka Dam is an earth, gravel, and rock-fill structure with a concrete core, a water face on a slope of 3 to 1, and a downstream face on a slope of 1½ to 1. The rock fill is 736 feet long, 25 feet wide on top, about 300 feet in average bottom width, and rises to a maximum of 86 feet above the river bed, which is of solid lava rock. At the south end of the dam is a concrete gravity section spillway 2,385 feet long and 2 to 15 feet high. The spillway follows the high points of a bed of lava rock in irregular alignment.

In the spring of 1910, the upper portion of the earth section of the dam was damaged by high water in Lake Walcott. This damage was repaired by Government forces. A concrete wall about 1,000 feet long and from 3 to 12 feet in height was built a short distance below the dam. This wall was intended to protect lands below it from erosion by water flowing over the spillway. It was later extended about 200 feet.

In 1911 the upper face of the embankment at the south end of the spillway was covered with rock riprap and grouted, and a masonry parapet wall 2 feet high was built along the top.

In September of the following year the main dam was cut by high waves on the lake. To repair the damage the water was drawn down 5 feet below the spillway crest, the rock paving was relaid and covered with 4 to 6 inches of concrete, and a concrete parapet wall 3 feet high was built on top of the dam.

In the fall of 1913, a series of four motor-operated taintor gates was built in the spillway about 900 feet from the south end of the main dam, in order to regulate the flow of water from Lake Walcott. Each gate is 10 feet wide and 12 feet high and weighs, with its anchorage, about 7½ tons. The gates have a total discharge capacity of from 8,000 to 10,000 second-feet and enable the flow to be controlled much more easily, rapidly, and accurately than can be done by the flashboards. A waste channel excavated below these gates has materially increased their effectiveness.

GRAVITY CANAL SYSTEMS.

The North Side Canal heads at the diversion dam with a normal capacity of about 1,400 second-feet. About 8 miles below the dam it divides into four main branches from which are taken smaller branches. About 72,000 acres of land are watered by the system, which includes about 20 miles of main canals and about 260 miles of laterals.

The South Side Canal has a capacity of 1,000 second-feet. The main canal is 13 miles long and waters an area of about 8,000 acres. About 20 miles of laterals distribute the water over this land. The main canal also carries water to supply the pumps, which are located at its lower end and raise water for the irrigation of about 50,000 acres of land under the pumping system. The Main South Side Canal was built by contract and has since been enlarged by Government forces. The smaller laterals were constructed by Government forces and by the settlers.

The construction of the North Side system was begun in the fall of 1904, about 2,000 feet of the main canal being included in the contract for the diversion dam. Most of the heavy work was done by contract, but the smaller laterals were built by Government forces or by the settlers. The principal difficulties encountered were due to the sandy soil, combined with the high winds, which completely or partially filled some of the ditches several times before they were in operation. The topography of the country, also, which in many places follows no general slope, but is simply a series of hills and hollows, made the location of the canals very difficult.

Proposals for the construction of the North Side Canal branches and laterals and the South Side Canal and laterals, for bridges and structures on both canal systems, and for gates and lifting devices for the canal headworks were opened on June 15, 1905. The work was executed under four contracts let in June and July, 1905, and was completed in July, 1907.

During 1910 and 1911 the enlargement of the Main South Side Canal was completed, the work being done by Government forces and under small contracts. The enlargement was necessary on account of the increased demands of the South Side pumping unit. The canal now has a capacity of 1,000 second-feet.

As originally planned the lateral system of the gravity unit of the project was to be built by the settlers and the ownership and operation of the laterals were to remain in their hands. This arrangement led to disputes and ill feeling, and the results were unsatisfactory both to the settlers and the Reclamation Service. In 1912 the service offered to take over these laterals by purchase or otherwise and to operate them. This policy has been continued, and at the end of June, 1916, about 258 miles of the community laterals have passed to the ownership of the Government, leaving only 14 miles still in the hands of the water users.

To facilitate compliance with the reclamation extension act, requiring that water shall be charged for on an acre-foot basis, a large number of measuring devices have been installed. These are of two general types, the Cippoletti weir, including both the overflow and the submerged types, and the submerged orifice. Approximately 1,660 of these had been installed to June 30, 1916.

POWER PLANT.

The power house is located on the downstream side of the concrete controlling works across the diversion channel. The building is of reinforced concrete and consists of a turbine floor, a generator floor, and galleries.

Proposals for furnishing the hydraulic machinery were opened on June 23, and contract was executed August 5, 1908. Proposals for the electrical apparatus were opened June 24, and this apparatus was furnished under four contracts executed in July, August, and December, 1908. The contracts included machinery for the three pumping stations as well as for the power house.

The construction of the power house and the installation of the machinery were accomplished by Government forces, the work being commenced in October, 1908. The first machinery, consisting of a main unit and one exciter, arrived in January, 1909. This machinery was hauled to the dam and installed, and operation was commenced on the 1st of May of that year. By January, 1909, the building was completed to the top of the generator floor, and on top of this was placed a wooden structure to protect the machinery from the weather. In June, 1909, the building construction was continued, the entire structure being completed in October. During the winter of 1909 and 1910 a second exciter and two additional alternators were installed. Space is provided in the power house for a total of five main power units of 1,800 horsepower each, normal rating.

In 1911 and 1912 the fourth and fifth generating units were installed in the power house at the Minidoka Dam, completing the equipment of the station.

The diversion channel below the power house was enlarged and deepened in 1914. The effective head on the turbines was thus increased about 1 foot, thereby increasing the capacity of the power house about 200 kilowatts.

A storehouse of reinforced concrete two stories high was erected in 1912. Besides storerooms, it contains a machine shop and the headquarters office for the engineer in charge of the dam and power system. Three frame cottages for employees were also built in 1913, and a steel-frame blacksmith shop and garage with walls of plaster on metal lath was constructed in 1914.

The Government reserve in the vicinity of the dam and power house and bordering on Lake Walcott has been named Walcott Park. An effort has been made gradually and without much expense to plant shade trees and grass, to lay out roads and walks, and generally to beautify these grounds to make them available as a pleasure resort for the people of the project. The park has become very popular and is used by large numbers of the settlers.

PUMPING STATIONS.

About 15 miles below the diversion dam, on the south side of the river, are located the three pumping stations. Station 1 draws its water from the Main South Side Gravity Canal and is designed to pump 575 second-feet of water. One-fourth of this amount will be required by the land under the first-lift canal, while the remainder is elevated at station 2, 1¾ miles distant, to the second-lift canal. A portion of the water in this canal is lifted for the third time at station 3, about one-half mile from station 2, into the third-lift canal. The lift at each station is approximately 31 feet.

Construction work was begun November 9, 1908, when ground was broken at station 1. During the summer and fall of 1909 the structures were completed, additional units installed, and the switchboards and other apparatus placed in their permanent positions. The structures were built and all apparatus was installed by Government forces. The apparatus was furnished under contract in connection with the machinery for the power house.

In 1911 and 1912 additional units were installed in the South Side pumping stations, bringing the stations up to the designed capacity of 575 second-feet total capacity at pumping station No. 1, 500 second-feet at No. 2, and 325 second-feet at No. 3. The pumps for these stations were designed in 1909. By 1914 the advance of the art made it possible to improve the pumps and obtain from them an increase of approximately 30 per cent in capacity by replacing the runners and making some slight changes in the diffusion vanes at an expense of less than $1,500 per unit. These changes were carried out by the engineering forces of the service. The stations now have the following units and capacities: Station No. 1, 5 units, 732 second-feet; station No. 2, 4 units, 617 second-feet; station No. 3, 3 units, 433 second-feet.

A reinforced-concrete building with a floor space 50 feet square was erected during 1915 at pumping station No. 2 as a permanent location for repair shops, storehouse, and garage for the South Side pumping stations. It has been equipped with facilities for handling all repair work quickly and cheaply.

A transmission line was built from the dam across country direct to the pumping stations in 1911, and afterwards it was extended to Burley and connected with the line from the north side, thus making a loop any section of which can be cut out for repair without interrupting service. A transmission line has also been built from Heyburn 7 miles to the West End pumping station and a low-voltage line extended from there to the 1817 scoop wheel.

The pumping unit of the Minidoka project has been made feasible largely because of the development by the Reclamation Service of the power possibilities at the Minidoka Dam. This dam was built primarily to divert the water of the Snake River into the main canals of the project. Prior rights to a part of the natural flow of the Snake River make it necessary during the entire irrigation season to let water pass the Minidoka Dam to projects farther down the river. A fall of 46 feet is made available by the dam, and, using this head, 10,000 electrical horsepower are developed. This power is transmitted at a pressure of 33,000 volts to the pumping stations. The lands supplied with water from the pumping stations are charged with their share of the actual cost of operating and maintaining the power house and transmission lines. These costs, with estimated depreciation added, amount to less than $3 per horsepower year. If interest on the investment at 6 per cent is also added, the cost would be about $6.50 per horsepower for the irrigation season. This, of course, represents the cost of delivering a very large block of power at high voltage and should not be confused with the cost of delivering in retail quantities. Commercial power companies in Idaho make rates as low as $18 per horsepower for the irrigation season.

The development and use of power for irrigation pumping at Minidoka leaves as a by-product a large amount of power available in the winter. Electricity is sold by the Reclamation Service both at wholesale to the distributing companies and at retail direct to the consumer at rates that compare favorably with the average rates made by power companies in the West. A number of mutual companies have been organized by the farmers to distribute electricity to their members, and in most cases these are doing a successful business. One interesting result of the availability of a large winter surplus of power has been the building up of a very large load by the heating of buildings with electricity. The retail rates for heating are extremely low, varying from $1 to 1.50 per kilowatt per month.

A number of small pumping plants have been built on the gravity unit to water tracts of land too high to be irrigated by gravity. These plants include the West End station, a substantial brick building with two centrifugal pumps having a capacity of 20 second-feet each and a lift of 17 feet, which waters about 2,200 acres; the A-4 station having a pump of the scoop-wheel type and watering about 730 acres; the 1,817 station, also of the scoop-wheel type, from which about 350 acres are watered; and small stations with centrifugal pumps on the 1,812 and 114 laterals. A public notice was issued May 27, 1916, announcing the charges, terms, and conditions of payment for the areas watered by all these pumping plants except the one on the 114 lateral.

PUMPING DISTRIBUTION SYSTEM.

The canal lengths and lifts of the pumping distribution system are as follows: From the end of the South Side Gravity Canal to the first pumping station the feeder is 1,650 feet in length, the lift at the station being 29.4 feet. From station 1 the first main canal winds along a bench in a westerly direction parallel to the river for a distance of 18 miles, irrigating about 11,000 acres. From the first-lift canal to the second pumping station the feeder, beginning at station 1, is approximately 1¾ miles in length, and the second lift raises the water 31.6 feet. The main canal for the second lift runs southwest and westerly for a distance of 26½ miles, and irrigates 15,900 acres. From the second to the third station the feeder is one-half mile in length, and the third lift raises the water 31.1 feet. The third-lift canal follows in general the same directions as the second-lift canal, is 25 miles long, and irrigates 23,400 acres, thus completing a total area of 50,300 acres irrigable by pumping.

In order to preserve the priority of filing on the waters of Snake River it became necessary to construct the main works for the south-side tract prior to June 23, 1908. As the land had been open to settlement under the reclamation act for several years, all of the farm units had been filed on, settlers were actually residing upon the land, and a water users' association had been incorporated in the spring of 1908. To expedite construction a contract was entered into between the water users' association and the Secretary of the Interior, whereby the former agreed to build the necessary canals and to issue as payment to the contractors and others performing work or furnishing materials certificates setting forth the value thereof, and receivable by the United States in reduction of water-right charges due, or to become due, upon lands within the project. Contracts were let in March, 1908, by the association for the construction of the first-lift canal. These were awarded entirely to local settlers, either singly or in groups, and for small stretches of work. Upon completion of this canal, the second lift was started, and then the third. A few heavy stretches were built by Government forces, but these were inconsiderable. In all, about 870,000 cubic yards of material were excavated, and the work was practically completed by the required date. No actual cash was paid for this work, but certificates to the amount of $150,400 were issued by the association.

Contracts for the first portion of the distribution system were let soon after this on the same basis as that on which the main canals had been built, and by this means and through work by Government forces water was made available in 1908 on a small area lying under the first lift.

In the spring of 1909, by order of the Secretary of the Interior, all outstanding contracts for work payable in certificates were completed, but no new contracts were let except upon a cash basis. The total value of certificate work done was $202,500. Informal contracts were then let to settlers for cash for the excavation of portions of the distribution system. The work was continued throughout the season and practically all of the laterals leading to Government farm units were completed. The structures were built by Government forces, all structures, with the exception of small timber checks and the farm-unit boxes, being constructed of plain and reenforced concrete, in a substantial and careful manner.

With the settlement and cultivation of the lands under the south-side pumping unit it was found desirable to enlarge B feeder, which carries water to pumping station No. 2, and also parts of H and J Canals. A third concrete siphon, 5 feet 3 inches in diameter, was built on the J Canal under Marsh Creek.

Two extensions to the pumping unit were constructed during 1915. A tract of about 940 acres at the west end of the project in township 10 south, ranges 21 and 22 east, was watered by laterals from the G and J Canals. Another tract containing about 700 acres , in township 10 south, range 24 east, Boise meridian, lying on the upper side of the Main South Side Canal and extending north from the pumping stations, was watered by the B-1 and B-2 laterals.

DRAINAGE.

The drainage system covers that portion of the gravity unit north of Snake River. It was made necessary by the rise of the ground water which occurred after irrigation was begun.

Drainage construction on an extensive scale began in 1910 with two steam dragline machines. Later two electric dragline machines were purchased and a small floating suction dredge was built. The drainage work was practically completed by the end of 1915. At that time there remained some deepening of drains and the installation of some minor structures. Up to June 30, 1916, 108 miles of open drains had been constructed and the wet area has been reduced to a negligible amount.

During the progress of the work a number of temporary pumping plants were built to lower the water until the principal lakes could be reached by deep drains. A permanent station was built at Boersch Lake in the west part of section 5, township 10 south, range 23 east, Boise meridian. This building is of steel and concrete construction and is equipped with two 25-second-foot centrifugal pumps on vertical shafts. The pumps discharge into the B-4 Canal, the drainage water being mingled with the other water in the canal and used for irrigation purposes.

In order to drain a large tract of low land situated in the northwest part of the project which was subject to overflow by storm water, a well was sunk into the lava rock to permit the water to be drawn off through fissures. This drainage well consists of a vertical shaft about 6 feet square and 40 feet deep, the lower two-thirds of which was in rock. At the bottom a drift was dug about 12 feet long, following what appeared to be a horizontal crevice varying in depth from a few inches to 18 inches.

The D-9 drain was built to drain into this well, and in the spring of 1916 nearly 23 second-feet of water was handled successfully.

Supplementing the drainage system, a silting plant was constructed on the North Side Canal about 3 miles from the dam. Here was situated a large body of clay, and by means of pumps and hydraulic giants it was comminuted and pumped into the main canal, thence carried down and allowed to deposit on the sides and bottom of the canals and laterals. It was thought that such a deposit would materially check seepage losses and therefore reduce the necessity for drains. When the clay at this place was exhausted the plant was moved to another body of it about one-half mile from the dam and it was treated in like manner. About 112,000 cubic yards of silt were thus handled and the results obtained have apparently justified the cost.

CONSTRUCTION DURING FISCAL YEAR.

Gravity canal system.—The construction of small laterals was continued. About 1¼ miles were built on the north-side portion of the unit and 3 miles on the south side. The necessary small structures were also constructed. The pumping system on the 114 lateral near Acequia, including the pumping station and distributing laterals, was completed and put into operation. A number of measuring devices were installed.

South Side pumping canal system.—Laterals in the B-1 and B-2 extensions were completed and the H-2 and H-2F laterals were built, a total of about 8 miles. A number of weirs and orifices were built.

Minidoka Dam road.—A wagon road to the dam was built jointly by the service and by Minidoka County. It is situated along the bank of Snake River, and gives much easier access to the dam than was formerly had.

Commercial power.—There was a large increase in the use of electricity for commercial purposes. At Rupert, Heyburn, and Burley there was a steady growth, which at the latter town included the installation of a heating system requiring 700 kilowatts in the new three-story high-school building and led to the signing of a contract for 1,500 kilowatts additional power. Outdoor transformer stations were built at Acequia and Marshfield. The former is of 25-kilowatt capacity and, in addition to the 114 pumping station, supplies power to settlers in the community. The Marshfield station has a capacity of 50 kilowatts and furnishes power for an elevator at that place, as well as the town and nearby farms. The construction of a transmission line 9 miles long to Albion and of a reinforced concrete transformer station there was completed and three 75-kilowatt transformers were moved there from Heyburn. The town and the State normal school are thus supplied with electricity under a contract guaranteeing a revenue of $47,000 in 10 years. A flour mill at Paul and a flour mill and an alfalfa-meal mill at Rupert were equipped for operating by electricity.

Drainage.—The floating clamshell dredge was operated throughout the year. It cleaned out the D-14 drain, then was moved to the main drain near Rupert, and by the end of June, 1916, had worked to within 2 miles of the end of the drain. The operations of the silting plant near the dam were completed, the plant was dismantled, and the pit filled with sand. The pumping station at Boersch Lake was completed and put into operation.

Surveys.—A number of surveys were made of nonirrigable areas of farm units in connection with the preparation of new farm-unit plats. Sectionizing surveys were made on the south side.

SEEPAGE AND DRAINAGE.

The drainage system on the project as originally planned and as authorized by the settlers is completed. Some additional work will be required on the part of districts or individuals before the full benefits will be obtained, but it will be a relatively small amount.

The total benefits derived from such a system are difficult to determine. It has been estimated, however, that the area damaged by seepage on the project increased from 945 acres in 1909 to 5,568 acres in 1913 and decreased to 543 acres in 1915. The area deducted from payment increased from 585 acres in 1909 to 6,777 acres in 1912 and was reduced to 543 acres in 1915. The number of farm units affected grew from 33 in 1909 to 506 in 1912 and declined to 100 in 1915.

The total discharge of all drains and pumping stations in 1915, except the D-9 drain, amounted to 80,110 acre-feet, and undoubtedly a large part of this would have remained on the ground if the drains had not been constructed. It is probable, also, that the seeped area would have continued to increase as it did up to 1913 if no relief had been provided.

Whether or not the results expected from the drainage system will be obtained will depend on the methods of irrigation employed. If water is used economically, the seeped area will be still further reduced, but conditions can be easily aggravated by excessive irrigation. The requirement that water shall be charged for according to the amounts used will, it is believed, have a beneficial effect along the lines indicated.

CONSULTING BOARDS.

From time to time numerous consulting boards have been convened to discuss and advise upon various matters relating to the construction and the operations of the project. A list of these boards, with the dates on which they met, the topics they were called to consider, and the names of the members, is given below.

Date.	Topic.	Members.
September, 1910	General report on the project for Board of Army Engineers.	F. H. Newell, director; A. P. Davis, chief engineer; F. E. Weymouth, supervising engineer; C. H. Paul, project manager.
Do	General feasibility of the project from an engineering and economic standpoint by Board of Army Engineers.	Gen. W. R. Marshall, Lieut. Col. John Biddle, Lieut. Col. W. C. Langfitt, Maj. Wm. W. Harts, Maj. C. W. Kutz, Maj. H. Burgess.
December, 1910	Commercial power and drainage costs.	A. P. Davis, chief engineer; F. E. Weymouth, supervising engineer; C. H. Paul, project manager.
September, 1911	Project costs and repayments.	F. H. Newell, director; A. P. Davis, chief engineer; Morris Bien, supervising engineer; D. W. Murphy, engineer; F. E. Weymouth, supervising engineer; P. M. Fogg, project manager; B. E. Stoutemyer, examiner.
April, 1912	Drainage	A. P. Davis, chief engineer; F. E. Weymouth, supervising engineer; P. M. Fogg, project manager.
February, 1913	Commercial power	A. P. Davis, chief engineer; F. E. Weymouth, supervising engineer; O. H. Ensign, chief electrical engineer; P. M. Fogg, project manager; Barry Dibble, engineer.
April, 1913	Drainage	F. E. Weymouth, supervising engineer; D. W. Murphy, engineer in charge of drainage; P. M. Fogg, project manager; F. N. Cronholm, superintendent of construction.

Date.	Topic.	Members.
October, 1913	Drainage	D. C. Henny, consulting engineer; D. W. Murphy, engineer in charge of drainage; F. E. Weymouth, supervising engineer; P. M. Fogg, project manager; F. N. Cronholm, superintendent of construction.
November, 1913	Enlarging capacity of South Side pumping stations and canals.	D. C. Henny, consulting engineer; F. E. Weymouth, supervising engineer.
May, 1914	Drainage	D. C. Henny, consulting engineer; F. E. Weymouth, supervising engineer; H. M. Schilling, project manager; F. N. Cronholm, superintendent of construction.
August, 1914	Project costs	A. J. Wiley, consulting engineer; F. E. Weymouth, supervising engineer.
January, 1915	Drainage, including Paul pumping station.	D. C. Henny, consulting engineer; F. E. Weymouth, senior engineer; H. M. Schilling, project manager; F. N. Cronholm, superintendent of construction; Barry Dibble, engineer.
February, 1915	Operation and maintenance charges.	F. E. Weymouth, senior engineer; H. M. Schilling, project manager; B. E. Stoutemyer, examiner
June, 1915	Final costs of project and distribution of same by board of review.	C. R. Burky, chairman; C. H. Paul, for Reclamation Service; A. C. De Mary, for gravity unit; Ben C. Edwards, for pumping unit.

OPERATION AND MAINTENANCE.

There were two breaks in the Main North Side Canal during the year. The first was in September, 1915, at the site of the silting plant, and necessitated shutting the water out of the canal for a week in order to make repairs. The other break, about 3 miles below the dam, occurred in May, 1916, during a heavy windstorm. Repairs were made in two or three days and service restored.

The four small pumping stations on the gravity unit were operated throughout the year. The 114 station was completed in time for the season of 1916. On the pumping unit, the service at all of the stations was continuous through the year. There were no serious breaks or accidents of any kind.

The melting snow in February, 1916, caused slight damage to canals, especially on the pumping unit, but repairs were easily made. Because of the heavy snowfall during the winter the normal flow of water in Snake River was much higher than usual, and it was expected that the demand for storage water would be reduced or at least delayed.

Much trouble was caused by the unusually early and heavy growth of aquatic plants in the canals, and various means were devised for combating it.

Historical review, Minidoka project.

Item.	1911	1912	1913	1914	1915	1916
Acreage for which service was prepared to supply water	112,000	112,000	116,600	117,000	120,000	120,300
Acreage irrigated	55,600	70,200	76,000	81,500	83,562	[1] 87,800
Miles of canal operated	315	382	457	520	590	615
Water diverted (acre-feet)	466,300	440,200	489,200	604,000	609,434	....
Water delivered to land (acre-feet)	327,100	304,172	383,000	353,000	323,479	....
Per acre of land irrigated (acre-feet)	5.9	4.3	5.0	4.3	3.9	....

[1] Estimated.

SETTLEMENT.

The year 1915 was unusually prosperous for the settlers. Crops were large and prices high. This condition is reflected in the bank deposits which show an increase of more than 50 per cent over 1915. The outlook during the spring of 1916 was not so encouraging. High winds blew out some crops and exceptionally cold weather killed or checked nearly all of the early vegetation. During June, however, there was a very marked improvement in conditions and prospects.

The estimated population of the farms in 1915 was 6,468, and of the towns was 4,100. In Rupert a modern hotel, a courthouse, a new depot, and many business houses and residences were either completed or under construction. At Burley, too, there were many new buildings.

A sale of State lands was held at Burley on April 22, 1916, at which all of the lands still owned by the State, about 6,000 acres, were offered. About 3,000 acres, or one-half of that offered, were sold at prices ranging from $10 to $54 per acre. It is expected that another sale will be held during the fall of 1916.

There have been a number of sales of farm lands during the year. Prices have ranged from $100 to $150 and upward per acre, depending on location and improvements.

Settlement data, Minidoka project.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	2,109	2,092	2,113	2,164	2,322
Population	4,400	4,800	5,200	5,800	6,468
Number of irrigated farms	1,606	1,708	1,741	1,713	1,760
Operated by owners or managers	1,406	1,496	1,525	1,402	1,352
Operated by tenants	200	212	216	311	408
Population		4,800	5,200	5,800	5,800
Number of towns	3	5	5	5	5
Population	1,700	2,200	3,000	3,500	4,100
Total population of towns and farms	6,100	7,000	8,200	9,300	10,568
Number of public schools		20	21	21	21
Number of churches	11	11	13	21	21
Number of banks	5	6	6	6	6
Total capital stock	$89,750.00	$97,500.00	$137,500.00	$140,000.00	$140,000.00
Total amount of deposits	$425,353.54	$547,234.84	$677,007.18	$821,909.28	$1,311,641.00
Total number of depositors	2,346	2,954	4,119	4,721	6,370

PRINCIPAL CROPS.

The most notable feature of the crop for 1915 is the increase in value over that for 1914. The average yield per acre on the gravity unit in 1915 was $23.13, as against $16.91 in 1914, and on the South Side pumping unit was $21.60, as compared with $16.65. Sugar beets show the greatest percentage of increase, both in acreage and value, of any of the main crops. The gain in acreage was nearly 100 per cent and in value was more than 112 per cent. The alfalfa-hay crop represents nearly 40 per cent of the value of all crops raised and leads all others, sugar beets being second and wheat third. Other crops in their order are potatoes, oats, and pasture.

On account of the cold weather in the spring of 1916 the first cutting of hay was light, but it is expected that later cuttings will be good. Prices for all crops promise to be unusually high and will partly compensate for the reduction in yield.

Crop report, gravity unit, Minidoka project, Idaho, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa hay	19,225	Tons	67,534	3.5	$6.00	$405,204	$21.07
Alfalfa seed	99	Bushels	292	3.0	9.00	2,628	26.55
Apples	238	Pounds	233,760	980.0	.02	4,675	19.65
Barley	1,560	Bushels	59,631	38.3	.65	38,760	24.85
Beans	25	..do	369	14.8	3.00	1,107	44.28
Beets, sugar	2,072	Tons	25,585	12.3	5.00	127,925	61.74
Clover hay	696	...do	2,286	3.3	6.00	13,716	19.71
Clover seed	174	Bushels	880	5.1	10.00	8,800	50.57
Corn	362	...do	9,040	25.0	1.00	9,040	24.97
Corn fodder	80	Tons	319	4.0	5.00	1,595	19.94
Fruits, small	30	Pounds	22,962	765.4	.05	1,148	38.26
Garden	367					16,343	44.53
Hay, mixed	170	Tons	473	2.8	6.50	3,074	18.08
Oats	3,815	Bushels	126,821	33.2	.45	57,069	14.99
Onions	7	...do	337	46.0	1.00	337	48.14
Pasture	5,602					43,559	7.77
Peas	213	Bushels	5,031	23.6	1.80	9,056	42.51
Potatoes	1,858	...do	203,877	150.0	.45	91,745	67.56
Rye	128	...do	2,569	20.0	.80	2,055	16.05
Wheat	4,596	...do	127,052	27.6	.80	101,642	22.11
Less duplicated areas	199						
Total cropped acreage	40,618	Total and average				939,478	23.18

Crop.	Area (acres).
Irrigated, no crop:	
Orchard	885
Young alfalfa	2,910
Ground fall plowed	213
Miscellaneous	1,743
Total	5,751
Less duplicated areas	995
Total irrigated acreage	45,374

Areas.	Acres.	Farms.	Per cent of project.
Irrigable area farms reported	58,447	1,139	81
Irrigated area farms reported	45,374	1,139	63
Under water-right applications	43,774		
Under rental contracts	1,600		
Cropped area farms reported	40,618	1,139	57

Crop report, South Side pumping unit, Minidoka project, Idaho, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	14,145	Tons	42,622	3.0	$6.00	$255,732	$18.08
Alfalfa seed	196	Bushels	453	2.3	9.00	4,077	20.80
Apples	2	Pounds	500	250.0	.02	10	5.00
Barley	890	Bushels	22,359	25.0	.65	14,533	16.33
Beans	35	...do	215	6.1	3.00	645	18.43
Beets	2,597	Tons	27,486	10.6	5.00	137,430	52.92
Clover	371	...do	619	1.7	6.00	3,714	10.00
Clover seed	549	Bushels	2,042	3.7	10.00	20,420	37.19
Corn	35	...do	380	10.9	1.00	380	10.86
Corn fodder	44	Tons	107	2.4	5.00	535	12.16
Garden	475	Acres				17,397	36.63
Hay, mixed	19	Tons	33	1.7	6.50	215	11.28
Mangles	37	...do	440	11.9	3.50	1,540	41.62
Oats	2,920	Bushels	78,615	27.0	.45	35,377	12.12
Onions	3	...do	352	117.3	1.00	352	117.33
Pasture	4,045	Acres				37,950	9.38
Peas	583	Bushels	10,191	17.5	1.80	18,344	31.46
Potatoes	1,623	...do	221,209	136.0	.45	99,544	61.33
Rye	10	...do	100	10.0	.80	80	8.00
Wheat	8,004	...do	172,203	21.5	.80	137,762	17.21
Less duplicated areas	193						
Total cropped acreage.	36,390	Total and average				786,037	21.60

Irrigated, no crop:	
Nonbearing orchard	503
Young alfalfa	724
Young clover	132
Fall plowed	329
Miscellaneous	1,080
Less duplicated areas	970
Total irrigated acreage	38,188

Areas.	Acres.	Farms.	Per cent of project.
Irrigable area farms reported	39,857	621	81
Irrigated area farms reported	38,188	621	78
Under rental contracts	38,188	621	78
Cropped area farms reported	36,390	621	74

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, NOVEMBER 3, 1915.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water will be furnished from the South Side pumping unit of the Minidoka project, Idaho, in the irrigation season of 1916 and each irrigation season thereafter, upon the filing of proper water-right application for the irrigable lands in the said unit shown upon the following farm-unit plats, viz, Boise meridian, townships 10 and 11 south, ranges 22, 23, 24, and 25 east, approved March 1, 1911, by the Secretary of the Interior and on file in the office of the project manager, United States Reclamation Service, Rupert, Idaho, and of the local land office at Hailey, Idaho.

2. Homestead entries of the farm units shown on said plats embracing public lands of the United States may be made on and after December 1, 1915, at 9 o'clock a. m. at the local land office, Hailey, Idaho, if found regular and accompanied by the certificate of the

project manager showing that water-right application has been filed and proper water-right charges deposited.

3. Warning is hereby expressly given that no person will be permitted to gain or exercise any right whatever under any settlement or occupation begun prior to 9 a. m. December 1, 1915, on any lands shown on said plats; provided, however, that this shall not interfere with any valid existing rights obtained by settlement or entry while the land was subject thereto. The project manager will receive water-right applications accompanied by the proper water-right payments in the form prescribed in paragraph 12, and issue certificates to applicants for public lands at any time after the date of this notice. Each application must be for a specific farm unit. More than one person may make water-right application for the same farm unit. Filing of water-right application and issuance of certificate gives no preference right to make entry. Acceptance of application will be indorsed thereon by the project manager when notified by the local land office that entry has been allowed. All other applications, with payments made, will be returned to applicants upon surrender by them of the certificate of filing issued by the project manager.

4. The limit of area per entry representing the acreage which, in the opinion of the Secretary of the Interior, may be reasonably required for the support of a family upon such lands is fixed at the amounts shown upon the plats for the several farm units. The maximum limit of area for which water-right application may be made for lands in private ownership shall be 160 acres of irrigable land for each landowner. Water-right applications for lands in private ownership may be made on and after the date of this notice. All water-right applications, whether for public or private lands, must be made to the project manager, United States Reclamation Service, Rupert, Idaho.

5. The water-right charges per acre of irrigable land are of two kinds—(*a*) a charge as hereinafter provided for the building of the irrigation system termed the "construction charge," and (*b*) an annual charge for operation and maintenance payable on March 1 of each year for the preceding irrigation season. The operation and maintenance charge for the irrigation season of 1916 shall be $1 per acre of irrigable land whether water is used thereon or not, which will entitle the water user to 1 acre-foot of water for each acre of irrigable land. Additional water supply will be furnished at the rate of 40 cents per acre-foot: *Provided*, That all water delivered in any irrigation season, before June 15 and after August 31, shall be charged as though it were one-half the amount of water actually delivered.

6. For lands entered subject to the provisions of the reclamation law the construction charge shall be $56.50 per irrigable acre, and for State or deeded lands, and for lands not entered subject to the reclamation law, the construction charge shall be $57.50 per irrigable acre.

7. For homestead entries made after August 13, 1914, and land in private ownership, which after August 13, 1914, is signed under contract with the South Side Minidoka Water Users' Association, water-right applications will be accepted at the construction charge applicable thereto under the provisions of section 6 hereof. An initial

payment of 5 per cent on account of the construction charge shall be made at the time of entry or filing of water-right application, which application must be on the form provided under the reclamation extension act. The remainder of the construction charge shall be paid in 15 annual installments, the first 5 of which shall each be 5 per cent and the remainder each 7 per cent of the total construction charge. The first of said annual installments shall become due and payable December 1 of the fifth calendar year after the initial installment, and subsequent installments shall become due on December 1 of each calendar year thereafter.

8. For lands shown on said plats and entered on or before August 13, 1914, or lands in private ownership which were subscribed to the South Side Minidoka Water Users' Association on or before August 13, 1914, the said construction charge shall be paid in 10 equal annual installments. The first of said installments shall be paid at the time of filing water-right application, and the second of such installments shall be due and payable December 1 of the subsequent year, and subsequent installments shall become due and payable December 1 of each year thereafter: *Provided, however*, That if water-right applications subject to the provisions of the reclamation extension act of August 13, 1914, be filed by the applicant within six months of this notice the first installment of the construction charge shall be due December 1, 1915, and subsequent installments December 1 of each year thereafter. The first four of such installments shall each be 2 per cent; the next two installments shall each be 4 per cent; the next 14 installments each 6 per cent of the total construction charge.

9. In case the lands of any water-right applicant shall have been credited on the books with any amount paid as rental charges he shall receive a like credit on the amount of construction charges levied against his land, and the credits therefor shall be applied as installments become due until fully absorbed.

10. Any water-right applicant or entryman may, if he so elects, pay the whole or any part of the construction charges owing by him within any shorter period than that provided by the public notices and orders applicable to his land.

11. In all cases where water-right application for lands in private ownership or for lands under entries not subject to the reclamation act shall not be made within one year after the date of this notice, the construction charge for such land shall be increased 5 per cent each year until such application is made and initial installment is paid.

12. All charges must be paid at the office of the United States Reclamation Service at Denver, Colo. Drafts on New York or Denver, or money orders, etc., should be made payable to the disbursing officer, United States Reclamation Service, Denver, Colo.

13. The method of determining the annual operation and maintenance charge, and the penalties for failure to pay the construction charge and the operation and maintenance charges when due, and discount allowed for prepayment of operation and maintenance charges for all lands, shall be as prescribed by the act of August 13, 1914.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, MARCH 4, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, notice is hereby given that hereafter until further notice for all lands under the gravity unit of the Minidoka project, Idaho, the operation and maintenance charge for any irrigation season shall be due and payable on March 1 of the following calendar year.

2. The operation and maintenance charges for the irrigation season of 1916 and for each irrigation season thereafter until further notice are as follows: Each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of 75 cents, which will permit delivery of not more than 2 acre-feet per acre, and should further quantities be needed they will be furnished at the rate of 8 cents per acre-foot.

3. The provisions of this public notice cover all lands subject to public notice heretofore issued for the said project.

4. Except as hereinabove provided, all the terms and provisions of existing public notices and orders, and in particular the public notice of February 27, 1915, for the Minidoka project, shall remain unchanged.

Andrieus A. Jones,
First Assistant Secretary of the Interior.

ORDER, APRIL 7, 1916.

1. In accordance with the provisions of a public notice dated December 30, 1911, for the Minidoka project, Idaho, notice is hereby given that a pumping plant for the irrigation of certain highland areas, embracing portions of section 36, T. 8 S., R. 24 E., B. M., and section 1, T. 9 S., R. 24 E., B. M., known as the 114 pumping extension of the gravity unit of the Minidoka project, is now under construction, and it is expected that water will be available for the irrigation of these lands during the season of 1916.

2. A list of the lands which may be irrigated, together with the approximate areas of each holding that may be watered from the completed works, may be examined at the office of the United States Reclamation Service at Rupert, Idaho. It is expressly understood that such areas are subject to revision for 1916 and subsequent years, if such revision shall be found necessary.

3. To all such lands, whose owners or occupants make written application to the project manager, water will be furnished on a rental basis during the irrigation season of 1916, upon completion of the works which will serve them.

4. For the irrigable area of each farm unit or private holding for which, during the season of 1916, application for water from the pumping system shall be filed, a minimum charge of 75 cents will be made. Payment of this charge will be due March 1, 1917, and payable at the office of the Reclamation Service, Rupert, Idaho. This

payment will entitle the applicant to 2 acre-feet of water for each acre of irrigable land covered by the application. Additional water will be furnished at the rate of 8 cents for each acre-foot. Such charges shall be subject to the same discount and penalties and to the provisions for cancellation and collection as provided in the reclamation extension act of August 13, 1914, for other operation and maintenance charges.

5. Public notice will be hereafter issued announcing the charges, terms, and conditions under which entries and water-right applications may be made for such lands.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, MAY 4, 1916.

Whereas under the provisions of the public notice issued March 4, 1916, the operation and maintenance charges for lands under the gravity unit, Minidoka project, Idaho, were announced as a minimum of 75 cents per irrigable acre, which will permit the delivery of not more than 2 acre-feet per acre, with a charge of 8 cents per acre-foot for all additional water furnished; and

Whereas the Minidoka irrigation district has applied for a revision of the said schedule of charges and an increase in the quantity of water to be furnished in consideration of payment of the minimum charge:

Now, therefore, in pursuance of the provisions of the reclamation law and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), public notice is hereby issued amending paragraph 2 of the public notice of March 4, 1916, so as to read as follows:

1. A map[1] of the project is shown on the reverse of this sheet, in which the irrigable lands are subdivided into three districts, namely, district 1, district 3, and district 6.

For the lands in district 1, 1 acre-foot of water per irrigable acre will be furnished in consideration of the payment of the minimum charge of 75 cents per irrigable acre.

For the lands in district 3, 3 acre-feet of water per irrigable acre will be furnished in consideration of the minimum charge of 75 cents per irrigable acre.

For the lands in district 6, 6 acre-feet of water per irrigable acre will be furnished in consideration of the payment of the minimum charge of 75 cents per irrigable acre.

2. The minimum charge per irrigable acre is 75 cents, and in consideration of such payment the amount of water furnished will be 1, 3, or 6 acre-feet per irrigable acre, depending upon whether the lands are in district 1, district 3, or district 6. Additional water as needed will be furnished at the rate of 15 cents per acre-foot.

3. Except as herein provided, the provisions of the said public notice of March 4, 1916, shall remain in full force and effect.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

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[1] Map not published in this report.

PUBLIC NOTICE, MAY, 25, 1916.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water will be furnished from the south side pumping unit of the Minidoka project, Idaho, in the irrigation season of 1916 and each irrigation season thereafter, upon the filing of proper water-right application for the irrigable lands in the said unit (1) included in a list approved April 18, 1911, by the Secretary of the Interior and shown on farm-unit plats of T. 10 S., R. 25 E., B. M.; T. 11 S., R. 22 E., B. M.; T. 11 S., R. 23 E., B. M.; and T. 11 S., R. 24 E., B. M.; and (2) shown on diagrams of lands in T. 10 S., R 21 E., B. M.; T. 10 S., R. 22 E., B. M.; and T. 10 S., R. 24 E., B. M., which three diagrams were approved by the director and chief engineer of the Reclamation Service on May 19, 1916. Copies of said farm-unit plats and of said diagrams are on file in the office of the project manager, United States Reclamation Service, at Rupert, Idaho, and in the local land office at Hailey, Idaho. Said amended plats and diagrams are supplemental to the plats approved March 1, 1911, by the Secretary of the Interior.

2. The following is a list of all lands covered by this public notice, with their irrigable areas for which water-right application may be made under the provisions of this public notice:

	Acres.
T. 10 S., R. 21 E., B. M.:	
Sec. 3—	
Lot 1	31.0
SE. ¼ NE. ¼	31.6
SW. ¼ NE. ¼	17.0
T. 10 S., R. 22 E., B. M.:	
Sec. 19—	
Lot 1	27.3
Lot 2	20.4
Lot 3	14.3
Lot 4	5.6
Sec. 20—	
Lot 2	48.1
Lot 3	31.2
NE. ¼ SW. ¼	40.0
NW. ¼ SE. ¼	40.0
SW. ¼ SE. ¼	36.9
SE. ¼ SW. ¼	36.3
SW. ¼ SW. ¼	34.7
Sec. 29—	
Unit A, E. ½ NE. ¼	71.7
Unit B, W. ½ NE. ¼	77.8
Unit C, E. ½ NW. ¼	71.5
NW. ¼ NW. ¼	29.3
Unit D, N. ½ SE. ¼	27.1
Sec. 30—	
NE. ¼ NE. ¼	36.2
NW. ¼ NE. ¼	27.5
NE. ¼ NW. ¼	35.0
NW. ¼ NW. ¼	36.9
SW. ¼ NW. ¼	32.8
SE. ¼ NW. ¼	40.0
SW. ¼ NE. ¼	36.2
SE. ¼ NE. ¼	16.2
Sec. 34, NW. ¼ SW. ¼	5.0
T. 11. S., R. 22 E., B. M.:	
Sec. 25—	
NE. ¼ NE. ¼	5.0
SW. ¼ SE. ¼	4.0
Sec. 14—	
NW. ¼ SE. ¼	10.0
NE. ¼ SW. ¼	10.0
NW. ¼ SW. ¼	2.0
T. 11 S., R. 23 E., B. M.:	
Sec. 19, lot 3	6.0
Sec. 27—	
NE. ¼ SE. ¼	11.0
NW. ¼ SE. ¼	3.0
Sec. 28—	
NE. ¼ NE. ¼	38.0
NW. ¼ NE. ¼	21.0
NE. ¼ NW. ¼	4.0
T. 10. S., R. 24 E., B. M.:	
Sec. 1—	
A, lot 1	22.0
G, SW. ¼ NE. ¼	23.9
H, SE. ¼ NE. ¼	30.0
J, NE. ¼ SE. ¼	0.7
K, NW. ¼ SE. ¼	24.6
L, NE. ¼ SW. ¼	19.5
P, SE. ¼ SW. ¼	39.0
Q, SW. ¼ SE. ¼	26.9
Sec. 12—	
B, NW. ¼ NE. ¼	7.7
C, NE. ¼ NW. ¼	40.0
D, NW. ¼ NW. ¼	7.6
E, SW. ¼ NW. ¼	2.3
F, SE. ¼ NW. ¼	39.1
G, SW. ¼ NE. ¼	16.7
K, NW. ¼ SE. ¼	29.2

T. 10 S., R. 24 E., B. M.—Contd.	
Sec. 12—Continued.	Acres.
L, NE. ¼ SW. ¼	40.0
N, SW. ¼ SW. ¼	7.3
P, SE. ¼ SW. ¼	39.8
Q, SW. ¼ SE. ¼	20.4
Sec. 13—	
A, NW. ¼ NE. ¼	8.2
C, NE. ¼ NW. ¼	33.7
D, NW. ¼ NW. ¼	33.3
E, SW. ¼ NW. ¼	38.5
F, SE. ¼ NW. ¼	34.3
G, SW. ¼ NE. ¼	19.3
K, NW. ¼ SE. ¼	5.5
L. NE. ¼ SW. ¼	30.0
M, NW. ¼ SW. ¼	40.0
N, SW. ¼ SW. ¼	39.2
P, SE. ¼ SW. ¼	18.2
Sec. 14—	
A, NE. ¼ NE. ¼	4.0
H, SE. ¼ NE. ¼	27.8

T. 10 S., R. 24 E., B. M.—Contd.	
Sec. 14—Continued.	Acres.
J, NE. ¼ SE. ¼	40.0
K, NW. ¼ SE. ¼	11.7
P, SW. ¼ SE. ¼	19.6
Q, SE. ¼ SE. ¼	39.1
T. 11 S., R. 24 E., B. M.:	
Sec. 10, SW. ¼ NE. ¼	12.0
Sec. 15, NW. ¼ NW. ¼	14.0
Sec. 21—	
NW. ¼ NE. ¼	5.0
NE. ¼ SW. ¼	2.0
NW. ¼ SW. ¼	24.0
Sec. 29—	
NE. ¼ SW. ¼	11.0
NW. ¼ SW. ¼	16.0
Sec. 30, NW. ¼ SE. ¼	12.0
T. 10. S., R. 25 E., B. M.:	
Sec. 30, SE. ¼ SE. ¼	7.0
Sec. 31, lot 3	6.0

3. The limit of area per entry, representing the acreage which in the opinion of the Secretary of the Interior may be reasonably required for the support of a family upon such lands, is fixed at the amounts shown upon the plats for the several farm units. The maximum limit of area for which water-right application may be made for lands in private ownership shall be 160 acres of irrigable land for each landowner. Water-right applications for lands in private ownership may be made on and after the date of this notice. All water-right applications must be made to the project manager, United States Reclamation Service, Rupert, Idaho.

4. The water-right charges per acre of irrigable land are of two kinds, (*a*) a charge as hereinafter provided for the building of the irrigation system, termed the construction charge, and (*b*) an annual charge for operation and maintenance payable on March 1 of each year for the preceding irrigation season. The operation and maintenance charge for the irrigation season of 1916 shall be $1 per acre of irrigable land, whether water is used thereon or not, which will entitle the water user to 1 acre-foot of water for each acre of irrigable land. Additional water supply will be furnished at the rate of 40 cents per acre-foot: *Provided*, That all water delivered in any irrigation season before June 15 and after August 31 shall be charged as though it were one-half the amount of water actually delivered.

5. For lands entered subject to the provisions of the reclamation law the construction charge shall be $56.50 per irrigable acre, and for State or deeded lands and for lands not entered subject to the reclamation law the construction charge shall be $57.50 per irrigable acre.

6. For homestead entries made after August 13, 1914, and land in private ownership, which after August 13, 1914, is signed under contract with the South Side Minidoka Water Users' Association, water-right applications will be accepted at the construction charge applicable thereto under the provisions of section 5 hereof. An initial payment of 5 per cent on account of construction charge shall be made at the time of entry or filing of water-right application, which application must be on the form provided under the reclamation extension act. The remainder of the construction charge shall be paid in 15 annual installments, the first five of which shall each be 5 per cent,

and the remaider each 7 per cent of the total construction charge. The first of said annual installments shall become due and payable December 1 of the fifth calendar year after the initial installment and subsequent installments shall become due on December 1 of each calendar year thereafter until the total construction charge is paid.

7. For lands entered on or before August 13, 1914, or lands in private ownership which were subscribed to the South Side Minidoka Water Users' Association on or before August 13, 1914, the said construction charge shall be paid in 10 equal annual installments. The first of said installments shall be paid at the time of filing water-right application and the second of such installments shall be due and payable December 1 of the subsequent year, and subsequent installments shall become due and payable December 1 of each year thereafter: *Provided, however*, That if water-right applications subject to the provisions of the reclamation-extension act of August 13, 1914, or an acceptance of the provisions of said extension act be filed within six months after the date of this notice, the first installment of the construction charge shall be due December 1, 1916, and subsequent installments December 1 of each year thereafter. The first four of such installments shall be 2 per cent, the next two installments shall each be 4 per cent, the next 14 installments each 6 per cent of the total construction charge.

8. In case the lands of any water-right applicant shall have been credited on the books with any amount paid as rental charges he shall receive a like credit on the amount of construction charges levied against his land, and the credits therefor shall be applied as installments become due until fully absorbed.

9. Any water-right applicant or entryman may, if he so elects, pay the whole or any part of the construction charges owing by him within any shorter period than that provided by the public notices and orders applicable to his land.

10. In all cases where water-right application for lands in private ownership or for lands under entries not subject to the reclamation act shall not be made within one year after the date of this notice the construction charge for such land shall be increased 5 per cent each year until such application is made and initial installment paid.

11. All charges must be paid at the office of the United States Reclamation Service at Rupert, Idaho. Drafts on New York or Denver, or money orders, etc., should be made payable to the special fiscal agent, United States Reclamation Service, Rupert, Idaho.

12. The method of determining the annual operation and maintenance charges and the penalties for failure to pay the construction charge and the operation and maintenance charges when due, and discounts allowed for prepayment of operation and maintenance charges for all lands shall be as prescribed by the act of August 13, 1914.

Bo Sweeney,
Assistant Secretary of the Interior.

PUBLIC NOTICE, MAY 27, 1916.

1. Public notice issued December 30, 1911, for the Minidoka project, Idaho, states that works providing for the irrigation of certain of the highland areas in the project have been, or will be constructed by

the United States, and that charges for such highlands shall become due at such date after water becomes available for their irrigation as may be announced by the Secretary of the Interior.

2. In pursuance of the said public notice of December 30, 1911, and of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplementary thereto, and particularly the reclamation-extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water will be available for the irrigation season of 1916 and each irrigation season thereafter, upon filing the proper water-right applications for the highland areas as shown on list approved May 27, 1916, by the Assistant Secretary of the Interior, a copy of which list is filed in the local land office at Hailey, Idaho, and in the office of the Reclamation Service at Rupert, Idaho. Said list covers land for which farm-unit plats have heretofore been approved by this department, in T. 9 S., R. 22 E., B. M.; T. 10 S., R. 22 E., B. M.; T. 10 S., R. 23 E., B. M.; T. 9 S., R. 24 E., B. M.; and T. 10 S., R. 24 E., B. M.

3. Homestead entries of the farm units shown on said plats, as amended by said list embracing public lands of the United States, may be made on and after June 28, 1916, at 9 o'clock a m., at the local land office, Hailey, Idaho, if found regular and accompanied by the certificate of the project manager, showing that water-right application has been filed and proper water-right charges deposited.

4. Warning is hereby expressly given that no person will be permitted to gain or exercise any rights whatever under any settlement or occupation begun prior to 9 a. m., June 28, 1916, on any lands shown on said plats, provided, however, that this shall not interfere with any valid existing rights obtained by settlement or entry while the land was subject thereto. All persons desiring to acquire any public lands shown on said plats shall execute homestead application, subject to the provisions of the reclamation act, in the manner required by law, which with the required fees and commissions, accompanied by certificate of the project manager as to the filing of water-right application and payment of water-right charges, as hereinafter provided, shall be presented to the local land office at Hailey, Idaho, in person, by mail, or otherwise, within a period of five days prior to June 28, 1916; that is, beginning not earlier than June 23, 1916. All entries filed as herein provided and reaching the local land office not later than 9 a. m., June 28, 1916, shall be held and treated as simultaneously filed. Applications presented after that hour will be received and noted in the order of filing. Any application not based on a prior-settlement right will be subject to valid settlement claims asserted in the manner required by law.

5. The register and receiver will carefully compare all applications simultaneously filed as aforesaid and will dispose of them as follows:

(*a*) Where there is no conflict the application shall be allowed, irrespective of whether settlement is alleged.

(*b*) In case of conflicting applications and only one of the applicants alleges prior settlement, his application shall be allowed and the others rejected.

(*c*) If two or more conflicting applications are received, each containing allegations of prior settlement, a hearing shall be ordered to determine the priority of right, and it shall be restricted to those alleging such right.

6. Where there are applications conflicting in whole or in part in which no one of the several applicants claims prior settlement, the register and receiver will write on cards the names of the several applicants, and each of these cards shall be placed in an envelope upon which there is no distinctive or identifying mark, and at 2 o'clock p. m. on the date of opening to entry, if practicable (if not, at the same hour one week later), after all the envelopes containing the names of the several applicants shall have been thoroughly mixed in the presence of such persons as may desire to be present, they shall be drawn and numbered in order. The cards as numbered and drawn will be securely fastened to the applications of the respective persons, and the applications shall be allowed in such order. Where any applicant fails to obtain land applied for by him he will be permitted to elect whether he will amend his application to embrace other lands not affected by pending applications and otherwise subject thereto when such amended application is presented, or withdraw his original application without prejudice, and in the event of such withdrawal the fees and commissions will be returned by the receiver and the water-right charges deposited will be returned by the project manager. Applications conflicting in whole with those previously allowed will be rejected in the usual manner.

7. The project manager will receive water-right applications accompanied by the proper water-right payments, which for the first payment from homestead entrymen, under paragraphs 3, 4, and 5 hereof, will be accepted in the form of New York draft or money order payable to the special fiscal agent, United States Reclamation Service, Rupert, Idaho, or in currency, and issue certificates to applicants for public lands at any time after the date of this notice. Each application must be for a specific farm unit. More than one person may make water-right application for the same farm unit. Filing of water-right application and issuance of certificate gives no preference right to make entry. Acceptance of application will be indorsed thereon by the project manager when notified by the local land office that entry has been allowed. All other applications, with payments made, will be returned to applicants upon surrender by them of the certificate of filing issued by the project manager.

8. The limit of area per entry representing the acreage which, in the opinion of the Secretary of the Interior, may be reasonably required for the support of a family upon such lands is fixed at the amounts shown upon the plats for the several farm units as amended by said list. The maximum limit of area for which water-right application may be made for lands in private ownership shall be 160 acres of irrigable land for each landowner. Water-right applications for lands in private ownership may be made on and after the date of this notice. All water-right applications, whether for public or private lands, must be made to the project manager, United States Reclamation Service, Rupert, Idaho.

9. The charges per acre of irrigable land are of two kinds, namely, (*a*) a charge for the building of the irrigation system, termed the construction charge, as hereinafter announced; (*b*) an annual charge for operation and maintenance, due March 1 of each year, for the preceding irrigation season, which for the irrigation season of 1916 shall be the same as for other lands on the project, except as to the

unentered lands under this public notice. For such unentered lands the first operation and maintenance charge will be that for 1917, due March 1, 1918.

10. For lands entered subject to the provisions of the reclamation law the construction charge shall be $30 per irrigable acre, and for State or deeded lands and for lands not entered subject to the reclamation law the construction charge shall be $40 per irrigable acre.

11. For highland areas shown on said list which became, or may become, subject to the reclamation law after August 13, 1914, water-right applications will be accepted at the construction charge applicable thereto under the provisions of paragraph 10 hereof. For such lands an initial payment of 5 per cent of the construction charge shall be made at the time of making entry or filing water-right application, which application must be on the form provided for under the reclamation-extension act. The remainder of the construction charge shall be paid in 15 annual installments, the first 5 of which shall each be 5 per cent and the remainder each 7 per cent of the total construction charge. The first of said 15 annual installments shall become due and payable December 1 of the fifth calendar year after the initial installment, and subsequent installments shall become due on December 1 of each calendar year thereafter until the construction charge has been paid.

12. For highland areas shown on said list which became subject to the reclamation law on or before August 13, 1914, and for which acceptance of, or water-right application under, the terms of the reclamation-extension act shall be duly filed within six months from the date hereof, the construction charge shall be paid in 20 annual installments, the first of which shall be due and payable December 1, 1916, and subsequent installments on December 1 of each year for 19 years thereafter. The first 4 of such installments shall each be 2 per cent, the next 2 installments each 4 per cent, and the next 14 installments each 6 per cent of the construction charge.

13. For highland areas shown in said list which became subject to the reclamation law on or before August 13, 1914, and the owners of which do not accept the reclamation-extension act as provided in paragraph 12, the construction charge shall be paid in 10 equal annual installments, the first of which shall be paid at the time of making water-right application, the second shall be due and payable on December 1 of the following year, and the remaining 8 installments on December 1 for 8 years thereafter.

14. Any water-right applicant or entryman may, if he so elects, pay the whole or any part of the construction charges owing by him within any shorter period than that provided by the public notices and orders applicable to his land.

15. In all cases where water-right application for lands in private ownership or for lands under entries not subject to the reclamation act shall not be made within one year after the date of this notice, the construction charge for such land shall be increased 5 per cent each year until such application is made and initial installment is paid.

16. All payments of water-right charges must be transmitted by the water user to the proper designated official, as provided in paragraph 8, in the form of currency, post-office money order, or bank draft.

Such money orders or drafts should be made payable to the said designated official.

17. The method of determining the amount chargeable for operation and maintenance and the penalties for failure to pay the construction charges and the operation and maintenance charges when due are prescribed by act of Congress of August 13, 1914 (38 Stat., 686).

Bo Sweeney,
Assistant Secretary of the Interior.

PUBLIC NOTICE, JUNE 10, 1916.

1. By order of May 10, 1913, certain lands shown on the farm unit plats for the Minidoka project, Idaho, were withdrawn from all forms of entry. A portion of these lands are hereby opened to entry. A list of the lands so opened to entry, together with the total, irrigable, and gravity area of each farm unit theref, is filed in the local land office at Hailey, Idaho, and in the office of the project manager of the Reclamation service at Rupert, Idaho, said list having been approved by the department on June 10, 1916.

2. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplementary thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water will be furnished to the said farm units in the irrigation season of 1916 and each irrigation season thereafter upon the filing of proper water-right application. Water-right applications must be made for the "irrigable area" shown on said list, but the amount of the construction charge, the due dates and amounts of installments of operation and maintenance and of the construction charge, as hereinafter announced, apply only to the "gravity area" as shown in said list. Public announcement of the amounts and due dates of such installments will be hereafter made covering irrigable land in said list not included in the gravity area.

3. Homestead entries of the farm units shown on said list embracing public lands of the United States may be made on and after July 12, 1916, at 9 o'clock a. m., at the local land office, Hailey, Idaho, if found regular and accompanied by the certificate of the project manager, showing that water-right application has been filed and proper water-right charges deposited.

4. Warning is hereby expressly given that no person will be permitted to gain or exercise any rights whatever under any settlement or occupation begun prior to 9 a. m., July 12, 1916, on any land shown on said plats: *Provided*, *however*, That this shall not interfere with any valid existing rights obtained by settlement or entry while the land was subject thereto. All persons desiring to acquire any public lands shown on said plats shall execute homestead applications, subject to the provisions of the reclamation act, in a manner required by law, which, with the required fees and commissions, accompanied by certificate of the project manager as to the filing of water-right application and payment of water-right charges as hereinafter provided, shall be presented to the local land office at Hailey, Idaho, in person, by mail, or otherwise, within a period of five days prior to July

12, 1916; that is, beginning not earlier than July 7, 1916. All entries filed as herein provided and reaching the local land office not later than 9 a. m., July 12, 1916, shall be held and treated as simultaneously filed. Applications presented after that hour will be received and noted in the order of filing. Any application not based on a prior settlement right will be subject to valid settlement claims asserted in the manner required by law.

5. The register and receiver will carefully compare all applications simultaneously filed as aforesaid and will dispose of them as follows:

(*a*) Where there is no conflict the application shall be allowed, irrespective of whether settlement is alleged.

(*b*) In case of conflicting applications, and only one of the applicants alleges prior settlement, his application shall be allowed and the others rejected.

(*c*) If two or more conflicting applications are received, each containing allegations of prior settlement, a hearing shall be ordered to determine the priority of right, and it shall be restricted to those alleging such right.

6. Where there are applications conflicting, in whole or in part, in which no one of the several applicants claims prior settlement, the register and receiver will write on cards the names of the several applicants, and each of these cards shall be placed in an envelope upon which there is no distinctive or identifying mark, and at 2 o'clock p. m. on the date of opening to entry, if practicable (if not, at the same hour one week later), after all the envelopes containing the names of the several applicants shall have been thoroughly mixed in the presence of such persons as may desire to be present, they shall be drawn and numbered in order. The cards as numbered and drawn will be securely fastened to the applications of the respective persons, and the applications shall be allowed in such order. Where any applicant fails to obtain land applied for by him he will be permitted to elect whether he will amend his application to embrace other lands not affected by pending applications and otherwise subject thereto when such amended application is presented, or withdraw his original application without prejudice, and in the event of such withdrawal the fees and commissions will be returned by the receiver, and the water-right charges deposited will be returned by the project manager. Applications conflicting in whole with those previously allowed will be rejected in the usual manner.

7. The project manager will receive water-right applications accompanied by the proper water-right payments, which for the first payment from homestead entrymen under paragraphs 3, 4, and 5 hereof will be accepted in the form of New York draft or money order payable to the special fiscal agent, United States Reclamation Service, Rupert, Idaho, or in currency, and issue certificates to applicants for public lands at any time after the date of this notice. Each application must be for a specific farm unit. More than one person may make water-right application for the same farm unit. Filing of water-right application and issuance of certificate gives no preference right to make entry. Acceptance of application will be indorsed thereon by the project manager when notified by the local land office that entry has been allowed. All other applications, with payments made, will be returned to applicants upon surrender by them of the certificate of filing issued by the project manager.

8. The limit of area per entry representing the acreage which, in the opinion of the Secretary of the Interior, may be reasonably required for the support of a family upon such lands is fixed at the amounts shown upon the plats for the several farm units. All water-right applications must be made to the project manager, United States Reclamation Service, Rupert, Idaho.

9. The water-right charges per acre of irrigable land are of two kinds:

(*a*) A charge of $30 per acre of irrigable land for the building of the irrigation system, payable as hereinafter provided, and in addition a charge equal to a proportionate share of the cost of the drainage system on the lands in the Minidoka project north of Snake River; the amount of the drainage charge and the date upon which it shall become due will be as hereafter announced by the Secretary of the Interior, and shall be payable on the same terms as for all other lands on the north side portion of the gravity unit of the project; and

(*b*) An annual charge for operation and maintenance, payable on March 1 of each year, for the preceding irrigation season: *Provided, however*, That if original homestead entry or original water-right application be filed after June 15 in any year, the first payment on account of operation and maintenance will become due March 1 of the second year thereafter. The amount thereof shall be hereafter announced.

10. An initial payment of 5 per cent on account of the construction charge shall be made at the time of entry or filing of water-right application, which application must be on the form provided under the reclamation extension act. The remainder of the construction charge shall be paid in 15 annual installments, the first 5 of which shall each be 5 per cent and the remaining 10 of which shall each be 7 per cent of the construction charge. The first of said 15 annual installments shall become due and payable December 1 of the fifth calendar year after the initial installment, and subsequent installments shall become due on December 1 of each calendar year for 14 years thereafter.

11. Any water-right applicant or entryman may, if he so elects, pay the whole or any part of the construction charges owing by him within any shorter period than that provided by the public notices and orders applicable to this land.

12. All water-right charges must be paid unless the department otherwise directs to the proper officer of the United States Reclamation Service at Rupert, Idaho, in cash, or by New York draft, money order, or check.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, JUNE 22, 1916.

The public notice of May 27, 1916, issued in connection with the Minidoka project, Idaho, is hereby amended as follows:

1. The last sentence of paragraph 9 shall read as follows:

> For lands subject to this public notice now unentered but entered on or before June 15, 1917, the first operation and maintenance charge will be that for 1917, due March 1, 1918.

2. Paragraph 10 of the public notice will read as follows:

> For lands entered subject to the provisions of the reclamation law the construction charge shall be $30 per irrigable acre, and for lands in private ownership and lands not entered subject to the reclamation law the construction charge shall be $40 per irrigable acre. In addition each acre of irrigable land shall be charged with a proportionate share of the cost of the drainage system on the lands in the said Minidoka project north of Snake River; the amount of the drainage charge and the date upon which it shall be become due will be as hereafter announced by the Secretary of the Interior and shall be payable on the same terms as for all other lands on the north-side portion of the gravity unit of the project.

3. The second line of paragraph 16 in the printed public notice will read as follows: " official as provided in paragraph 7 in the form of currency, post-office money order or bank draft. Such "

The public notice otherwise shall remain in full force and effect.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, JUNE 26, 1916.

The public notice of May 4, 1916, issued by this department for the Minidoka project, Idaho, is hereby amended as follows:

1. The second sentence in paragraph No. 1 of said public notice shall read as follows:

> For the lands in district 1, 2 acre-feet of water per irrigable acre will be furnished in consideration of the payment of the minimum charge of 75 cents per irrigable acre.

2. Paragraph No. 2 of said public notice will read as follows:

> 2. The minimum charge per irrigable acre is 75 cents, and in consideration of such payment the amount of water furnished will be 2, 3, or 6 acre-feet per irrigable acre, depending upon whether the lands are in district 1, district 3, or district 6. Additional water as needed will be furnished at the rate of 15 cents per acre-foot.

The public notice of May 4, 1916, shall otherwise remain in full force and effect.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 704.]

Feature costs of Minidoka project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys:		
Examination and preliminary	$66,582.84	
Engineering	19,697.60	
Use of water	4,435.34	$90,715.7
Storage system:		
Raising spillway, Walcott reservoir	33,975.16	
Spillway gates and channel, Walcott reservoir	22,377.65	
Jackson Lake Dam	417,224.16	
Jackson Lake Bridge	33,263.07	506,840.04
Pumping for irrigation:		
Temporary pumping plant	7,886.25	
South Side pumping stations	461,934.42	
North Side pumping stations	34,368.60	504,189.27

Feature costs of Minidoka project to June 30, 1916—Continued.

Features.	Subfeature.	Principal feature.
Canal system:		
Minidoka Dam and spillway	$547,663.66	
River protection	21,388.70	
Right of way above dam	46,545.63	
Main North Side Canal	253,445.79	
Main South Side Canal	304,063.00	
Waste canals	46,533.76	
A, B, and C Canals	381,567.14	
Structures	87,653.72	
Monarch and Porter litigation	725.59	
Feeder canals	77,489.85	
Supplemental construction	712,474.76	$1,802,790.92
Lateral system:		
General force account	251,760.78	
Structures	12,037.82	
Purchase and rebuilding laterals	187,914.56	
Measuring devices	44,704.64	
High land	27,475.54	
G, H, and J laterals	520,149.82	
Right of way	1,524.19	
West end laterals	44,7 8.81	1,090,316.16
Power system:		
Power plant	447,427.65	
Transmission lines	83,088.08	
Substations	49,854.05	580,369.78
Permanent improvements and land:		
Buildings at dam	47,892.02	
Buildings at Rupert	19,516.23	
Buildings at pumping stations	23,339.00	
Buildings at Burley	9,172.12	
Roads	1,615.02	101,534.39
Telephone system:		
Original gravity unit	13,799.71	
South Side pumping unit	14,596.30	28,396.01
Operation and maintenance during construction		83,675.41
Plant accounts		14,614.52
Gross cost of construction of project to June 30, 1916		5,480,202.96
Less revenues earned during construction period:		
Rental of buildings	7,007.57	
Rental of grazing and farming lands	904.45	
Rental of irrigation water	53,271.20	
Contractors' freight refunds	552.39	
Forfeitures by defaulting bidders and contractors	90.00	
Sale of town-site lots	131,158.51	
Other revenues, unclassified	9,228.92	
Profit on hospital operations	1,292.56	203,505.60
Net cost of construction of project to June 30, 1916		5,276,697.36

Estimated cost of contemplated work, Minidoka project, during the fiscal year 1917.

Features.	Estimated cost.
Examination and surveys	$4,000
Pumping for irrigation	2,400
Canal system	1,000
Lateral system	17,000
Power system	3,500
Permanent improvements and land	700
Operation and maintenance	170,000
Stores and other operations	2,000
Plant and equipment	6,575
Total	207,175

IDAHO-WYOMING, JACKSON LAKE ENLARGEMENT.

F. A. BANKS, engineer, Moran, Wyo.

SUMMARY OF GENERAL DATA FOR JACKSON LAKE ENLARGEMENT TO JUNE 30, 1916.

Finances.

Estimated cost of completed work			$800,000
Total construction cost to June 30, 1916			$711,274.38
Per cent complete, June 30, 1916			89
Appropriation for fiscal year 1917, total			$241,000
Allotment for construction, fiscal year 1917			$116,615
Estimated per cent complete, June 30, 1917			100
Appropriation, fiscal year 1916			$476,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation:			
Disbursements	$146,332.36		
Transfers	7,282.01		
		$153,614.37	
Registered liabilities chargeable to 1916 appropriation		14,041.45	
			167,655.82
Unencumbered balance, July 1, 1916			308,344.18

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

The Jackson Lake enlargement consists in the construction of the new Jackson Dam enveloping the Jackson Lake Dam, completed in 1911 under the Snake River storage, thereby raising the maximum water surface of the Jackson Lake Reservoir 17 feet and increasing its storage capacity from 380,000 acre-feet to 789,000 acre-feet. This work is provided for by the act of June 17, 1902 (reclamation act), and the act of February 21, 1911 (Warren Act), and had its genesis in the contract of February 25, 1913, between the United States and the Kuhn Irrigation & Canal Co. and the Twin Falls Canal Co. Under the provisions of this contract the work is done by the Reclamation Service with funds advanced by the above companies and the title and control remain in the United States.

Fiscal year 1912–13.—Camp was opened on May 7, 1913, and the balance of the fiscal year was spent in wash boring, test-pit digging, logging, constructing plant, making right of way and topographic surveys, preparing plans and construction programs, and organizing for the season's work.

Fiscal year 1913–14.—Just as the work was getting well under way, and equipment, materials, and supplies were about to be shipped, word was received on July 8, 1913, that the Kuhn Irrigation & Canal Co. was in financial difficulties and that the shipment of all orders should be stopped. Not until August 17, 1913, was the future policy determined upon. It was then too late to do anything in the way of construction that season, but preparations were made for resuming work the following spring. The principal part of the crew was disbanded on September 15.

Meanwhile testing, logging, and constructing plant were continued; the wagon road and road houses were put in order; the coal mine was opened; and wood cutting started to provide fuel for the following season.

All orders placed were released and the wares freighted to Moran.

During the winter machinery was purchased for a 12-inch suction dredge and freighted over the Teton Pass, and the cordwood was hauled to camp.

On April 4, 1914, orders were received to proceed with the work, and the camp was reopened on the 24th.

The work outlined for the season consisted in laying the foundation for the entire dam and bringing the concrete work to such a point that work could be resumed on it the following year, and at the same time furnish the projects with a reservoir full of stored water. The suction dredge was to be constructed and tried out.

Topography was taken of the dam site and the final location of the head gates and dike decided upon. The designs were revised somewhat and the works staked out.

Construction work opened with the building of the south cofferdam to connect the south abutment with the shore and permit the excavation of the south shore and a portion of the south dike. This excavation was well under way at the close of the fiscal year.

A sawmill was constructed and was running on May 6. On May 31 it burned down, but was reconstructed and running by June 29, 1914.

Fiscal year 1914–15.—As it was impossible to agree with Mr. B. D. Sheffield upon the value of certain lands needed for construction purposes, a condemnation suit was filed and possession granted by the court on July 21. This permitted the completion of a temporary bridge below the dam and greatly facilitated the excavation below the south end, which was being carried on by teams and by sluicing into the river.

On August 14 the water surface in the reservoir had dropped sufficiently to permit the south cofferdam to be wrecked, and the excavation carried down as rapidly as the fall in the lake would permit. The first forms were in place for the west wing of the south abutment on September 14 and the first concrete was laid there on the 19th. On October 18 the south third had been completed to within 21 feet of the top and was thus left until the following spring.

On September 18 the delivery of stored water was completed. The upper cofferdam was accordingly closed and the inflow allowed to accumulate in the lake. The excavation for the north two-thirds of the dam and the north abutment was completed, and on November 16 the middle third of the dam had been brought up even with the south third, and the north third and north abutment had been brought up to elevation 46, where work could be resumed readily in the following spring.

On October 25 the natural flow was allowed to pass through the south third of the dam, thus preventing a further increase in the head on the upper cofferdam.

Sheet pile cut-offs were driven between the old and new north abutments, some puddling and rock filling done around the north abutment, the upper cofferdam excavated, and the construction work was closed down for the winter, leaving coal mining and hauling in progress until March 4, 1915.

In the meantime the suction dredge had been constructed and tried out. It was decided to replace the jet agitating apparatus with a cutting bar. The dike foundation was partly stripped of vegetable matter and sheet piling driven at the outer end.

Construction work was resumed on April 8, 1915, with the continuation of driving of sheet piles in the dike. The downstream row was completed on June 24.

On April 11 the stripping of the dike foundation was resumed and completed on June 11.

On April 12 concreting was resumed and by June 16 was complete, with the exception of a small amount in the north core wall.

On April 27 work on constructing the dike with the dredge was resumed. An attempt was made to deposit the material on a flat slope, leaving the coarse material on the outside and the fine near the center. Owing to the fact that a large percentage of the fine material was thus being washed away a new method was adopted consisting in constructing the dike in sections from 500 to 1,000 feet in length, thus forming summit pools in which a much larger percentage of the fine material was retained. The slopes were retained by vertical fences. This method was quite successful and was pursued to completion.

On May 6 a power scraper was started excavating material from the river channel below the dam and depositing it in the blanket below the north end of the gate section.

Logging operations were carried on from May 17 to June 20, and sawmill operations from May 23 to June 30.

CONSTRUCTION DURING FISCAL YEAR.

Hydraulic fill was continued until November 26, when work was closed down on account of cold weather; all portions of the dike were then complete to elevation 6760 or higher.

Between September 7 and October 10 a row of sheet piles was driven along the upstream toe of the old dike for a distance of 560 feet, completing this class of work.

The concrete core wall was completed on November 18.

From July 1 to November 16 considerable material was placed in the dike and blanket with power scrapers and slack-line cableways excavating from the river channel above and below the dam.

Sluice gate operating devices, radial gate frames, and fishway gates were all placed during the summer.

From July 23 to November 16 the stripping of the quarry was carried on, and the material obtained was deposited in the dike. The quarry was opened shortly afterwards, and the delivery of rock for riprap and rock fill carried on throughout the winter.

Coal mining and hauling was continued steadily from July 1 to February 21.

Toward the latter part of 1915 a slack-line cableway was erected below the south end of the dam to excavate material from the river channel to be conveyed to the dike in trains. During the winter two more were erected at the north end of the core wall to expedite the construction of the dike at this its lowest point. Material was obtained from a borrow pit 250 feet above the toe of the dike. One or more of these cableways was in operation from April 11 to the end of the fiscal year.

On April 8 hydraulic fill with the dredge was resumed and was complete on June 25.

Some riprap was placed in the fall of 1915, and when work was opened up in the spring a large crew was employed and good progress made.

At the close of the fiscal year the work was rapidly nearing completion, and the prospects were that it would be entirely finished by October 1, 1916.

BOARD REPORTS.

Board report May 19, 1913: F. E. Weymouth, A. J. Wiley, C. W. Farmer, and F. A. Banks.

Board report July 22, 1913 (telegram): F. E. Weymouth, A. J. Wiley, C. W. Farmer, and F. A. Banks.

Board report August 12, 1913: F. E. Weymouth, A. J. Wiley, C. W. Farmer, and F. A. Banks.

Conference February 15, 1914, approving dredge plans and method of constructing the dike therewith: A. P. Davis, F. E. Weymouth, D. C. Henny, A. J. Wiley, and F. A. Banks; no report.

Board report May 24, 1915: F. E. Weymouth, A. J. Wiley, F. T. Crowe, and F. A. Banks.

PURCHASES OF RIGHTS AND PROPERTY.

No purchases of rights or property have been made, but by act of Congress approved June 28, 1916, the title to certain lands belonging to B. D. Sheffield will be transferred to the United States in return for certain Government lands to which Mr. Sheffield will be given patent.

FINANCIAL STATEMENT.

[Financial statement in detail showing assets, liabilities, reserves, and capital, given in appendix, p. 706.]

Feature costs of Jackson Lake enlargement to June 30, 1916.

Features.	Sub-feature.	Principal feature.
Storage system, Jackson Lake Reservoir:		
Preliminary and general work	$27,108.60	
Dam and spillway	662,021.19	
Administrative general expense	7,629.62	$696,759.41
Permanent improvements and land:		
Buildings	693.09	
Roads	11,157.10	
Administrative general expense	13.56	11,863.75
Telephone system		2,651.22
Plant accounts		5,558.36
Gross cost of construction to June 30, 1916		716,832.74
Add losses on incidental operations during construction period:		
Rental of buildings	[1] 804.80	
Forfeitures by defaulting bidders and contractors	[1] 689.65	
Loss on mess-house operations	11,358.60	
Profit on mercantile store operations	[1] 7,558.62	
Loss on hospital operations	2,162.66	4,468.19
Net cost of construction to June 30, 1916		721,300.93

[1] Deduct.

Estimated cost of contemplated work of Jackson Lake enlargement during fiscal year 1917.

Features.	Sub-feature.	Principal feature.
Storage system:		
Preliminary and general work	$2,680.00	
Dam and spillway	92,605.00	
		$95,285.00
Permanent improvements and land:		
Buildings	570.00	
Real estate	20,599.50	
		21,169.50
Telephone system: Telephone lines		160.00
Messes		8,202.50
Mercantile stores		5,420.00
Hospitals		930.00
Total		131,167.00

KANSAS, GARDEN CITY PROJECT.

LOCATION.

Counties: Finney and Kearny.
Townships: 23 and 24 S., Rs. 32 to 34 W., sixth principal meridian.
Railroad: Atchison, Topeka & Santa Fe.
Railroad stations: Garden City, 3,500, and Deerfield, 200.

WATER SUPPLY.

Source of water supply: Shallow wells near Arkansas River, and natural flow from the river.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916: No water being supplied by Reclamation Service, on account of failure of water users to pay back charges.
Length of irrigating season: From April 1 to October 31—214 days.
Average elevation of irrigable area: 2,925 feet above sea level.
Rainfall on irrigable area: 19 inches, average.
Range of temperature on irrigable area: —20° to 105° F.
Character of soil of irrigable area: Fertile black sandy loam.
Principal products: Alfalfa, sugar beets, melons, sweet potatoes, small fuits.
Principal markets: Garden City, Kans.; Kansas City, Mo.; Chicago, Ill.

LANDS OPENED FOR IRRIGATION.

Dates of public notices: March 6, 1908, and November 30, 1908.
Location of lands opened: Tps. 23 and 24 S., Rs. 32, 33, and 34 W., sixth principal meridian.
Irrigable lands opened: 10,677 acres, all in private ownership.
Limit of area of farm units: 160 acres.
Duty of water: 2 acre-feet per acre per annum at the farm.
Building charge per acre of irrigable land: $37.50.
Annual operation and maintenance charge: $2.75 per acre of irrigable land.

CHRONOLOGICAL SUMMARY.

Reconnoissance made and preliminary surveys begun in 1904.
Construction recommended by board of engineers September 5, 1905.
Construction authorized by Secretary October 5, 1905.
Power plant completed July, 1907.
Conduit and siphon completed July, 1907.
First irrigation by Reclamation Service, season of 1908.
Wells completed, April, 1908.
Pumps: 10 installed in 1907, 13 installed in 1908.
Entire project 98 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Garden City project provides for the utilization by pumping of the underground flow of the Arkansas River Valley to supplement the normal flow of Arkansas River distributed through the Farmers' ditch to irrigate lands northwest of Garden City, Kans.

A powerhouse is located on the main line of the Atchison, Topeka & Santa Fe Railroad at Deerfield, Kans., for the transmission of electrical energy to 23 pumping stations, located along a concrete-lined canal 20,000 feet in length. The pumps are connected at three of these stations to twelve 15-inch wells each, and at 20 stations to 9 wells each. All of the features of this plan are completed.

GENERAL DATA FOR GARDEN CITY PROJECT TO JUNE 30, 1916.

Areas:		
Irrigable acreage when project is completed		10,677
Private land, June 30, 1916		10,677
Finances:		
Estimated cost of completed project		$377,136.78
Total construction cost to June 30, 1916		$375,434.64
Per cent complete, June 30, 1916		100
Appropriation for fiscal year 1917, total		$1,600.00
Allotment for construction, fiscal year 1917		$1,600.00
Estimated per cent complete, June 30, 1917		100
Announced construction charges per acre		$37.50
Appropriation, fiscal year 1916		$2,000.00
Expenditures during fiscal year chargeable to 1916 appropriation:		
Disbursements	$1.06	
Transfers	4.35	
		5.41
Unencumbered balance, July 1, 1916		1,994.59

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

POWER PLANT.

The power plant is located adjacent to the Atchison, Topeka & Santa Fe Railroad near Deerfield, Kans., and consists of a pressed-brick building, in which are located two 350-horsepower De Laval steam turbines, direct connected to two 60-cycle, 3-phase, alternating-current dynamos of the revolving field, stationary armature type, having a combined capacity of 225 kilowatts and generating current at 6,600 volts. Each alternator is direct connected with a direct-current exciter, supplying excitation at 125 volts. The power is supplied from two 203-horsepower Sterling boilers, set singly. The boilers generate steam at 160 pounds pressure and are equipped with superheaters raising the temperature of the steam to 450° F. and with feed pumps and a Cochrane feed-water heater and purifier. The steam turbines operate with their highest economy at 160 pounds steam pressure and are each equipped with a service condenser of 5,200 pounds hourly capacity, with cooling water at 65° F. and a vacuum pump maintaining a vacuum of 29 inches. The cooling water is furnished by an 8-inch electrically driven centrifugal pump.

The building and the foundations for the machinery were constructed by Government forces and the machinery was furnished under contract. The plans and specifications for the machinery, provided for the use of either coal or oil as fuel and for steam turbines, reciprocating steam engines, or gas engines for the production of power. Proposals were opened on May 28, 1906. The successful bidder submitted a proposal providing for steam turbines, with coal as fuel, as indicated in the foregoing description of the plant. During the winter of 1908 and 1909, however, patent furnaces and burners for the use of oil as fuel were installed under the boilers and a 55,000-gallon concrete oil-storage tank was constructed. A contract for the power-plant machinery was awarded on June 21, 1906, and the plant was completed in July, 1907.

CONDUIT AND STRUCTURES.

The plans for the development of underground water provided for 23 groups of wells, 10 north and 13 south of Arkansas River, from which water would be discharged into a concrete-lined conduit leading to the Farmers' ditch. For each group of wells there is a concrete pump house 10 feet wide, 12 feet long, and 9¾ feet high to the eaves. The pump houses are located approximately 1,000 feet apart. Three of the groups contain 12 wells each and the others 9 wells each, making a total of 216 wells. The wells are 15 inches in diameter and from 35 to 60 feet in depth. Each well is lined with galvanized-iron casing, perforated below the water plane with rectangular slots $\frac{3}{16}$ by 1¼ inches. Each group of wells was estimated to have a capacity of about 5 second-feet with a water-plane draw down of 18 feet. The conduit is about 20,000 feet in legth, 6,927 feet being in a closed-box form and the remainder being an open trapezodial canal. The conduit passes under an irrigation ditch through a concrete siphon and under Arkansas River through a large wooden siphon 900 feet long. The conduit passes the various pumping stations in succession and gradually increases in carrying capacity throughout its length. In June, 1906, specifications for the conduit and structures were prepared and advertisement issued for proposals to be opened July 6, 1906. No proposals were received and the work was readvertised, the proposals were opened on September 28, 1906. All bids were unsatisfactory and were rejected, and construction by Government forces was authorized on October 9, 1906. An informal contract for the construction of the shallow wells was entered into on November 7, 1906, and the wells were completed in readiness for the irrigation season of 1908. The concrete-lined conduit constructed by Government forces was completed in June, 1907, and the siphon under the river was finished one month later.

PUMPING MACHINERY.

Each pumping unit is supplied with a vertical centrifugal pump direct-connected to a 25-horsepower 3-phase induction motor. The pumps are of top suction, inclosed balanced impeller, vertical-shaft type, and have a capacity of 5 second-feet each at 580 revolutions per minute. The impellers are balanced by means of water pressure. Each pump is provided with a small rotary priming pump, belt driven from the common shaft of the main pump and its motor. The motors have a capacity of 25 horsepower, are supplied with current at 220 volts, and are equipped with starting compensators. The electric current is transmitted to the pump houses at the generator voltage of 6,600, and is there changed to the motor voltage of 220 by oil-cooled transformers located in the pump houses. The transmission line is 25,000 feet in length and was constructed by Government forces.

Proposals for the pumping machinery were opened on July 7, 1906. The specifications provided for furnishing ten or more pumping units, and on September 1, 1906, contract for furnishing ten 9-inch centrifugal pumps connected to 25-horsepower electric motors was executed. Proposals for 13 additional centrifugal pumps with 25-horsepower electric motors were opened on January 2, 1907; and on January 27 a contract was executed for furnishing thirteen 10-inch pumps under these specifications. The ten 9-inch pumps were installed and ready for operation by September, 1907, and the thirteen 10-inch pumps were installed during June and July, 1908.

OPERATION AND MAINTENANCE.

Payment of the Reclamation Service charges has not been made since 1909, and inasmuch as the public notices which have been issued provide that no water shall be furnished in any irrigation season until the operation and maintanance charges of the previous season have been paid, the plant has been closed. The plant itself is not a failure, but the people will not try to make it a success. Since 1909 no water has been pumped, and maintenance work has been confined to the necessary care of the plant.

FUTURE PLANS.

During 1915 efforts were made to interest the Garden City Sugar & Land Co. in the purchase or lease of the wells and plant or any part thereof, but after considerable correspondence the matter was dropped without any definite conclusion being reached.

FINANCIAL STATEMENT.

[Financial statement, in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 707.]

Feature costs of Garden City project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys		$7,618.72
Pumping for irrigation:		
Well pits and shafts	$53,489.51	
Pumping plants	51,694.13	
		105,183.64
Canal system:		
Temporary structures	2,497.42	
Concrete conduit	56,473.73	
Bridge across conduit	150.30	
Concrete culvert	97.76	
Arkansas River siphon	26,785.15	
Right-of-way fence	2,541.81	
		88,546.17
Power system:		
Power house building and plant	82,273.12	
Electrical installation	15,410.75	
Soft water, well No. 1	1,219.37	
Coal scales, trestle, and coal bins	5,445.08	
Industrial and railroad track	1,556.30	
Circulating 12-foot well	13,890.00	
Soft water, well No. 2	1,072.71	
Soft water, well No. 3	1,543.73	
Cooling tower	1,710.24	
		124,121.30
Farm units		285.66

Feature costs of Garden City project to June 30, 1916—Continued.

Features.	Subfeature.	Principal feature.
Permanent improvements and lands:		
Real estate	$1,349.23	
Headquarters buildings	4,866.87	
Lubricating-oil house	374.85	
Work shop	410.74	$7,001.69
Operation and maintenance during construction (water rental basis)		48,405.97
Plant accounts		4,302.30
Gross construction cost		385,465.35
Less revenues earned during construction period:		
Rental of buildings	859.58	
Contractor's freight refunds	1,911.73	
Forfeitures by defaulting bidders and contractors	5,800.00	
Other revenues unclassified	13.00	
Profit on mess-house operations	860.82	
Profit on hospital operations	585.58	10,030.71
Net cost of construction of project to June 30, 1916		375,434.64

Estimated cost of contemplated work, Garden City project, during fiscal year 1917.

Pumping for irrigation: Care of and disposal of plant — $1,600

MONTANA, HUNTLEY PROJECT.

R. H. Fifield, project manager, Huntley, Mont.

LOCATION.

County: Yellowstone.

Townships: 2 and 3 N., Rs. 27 to 31 E., Montana meridian.

Railroads: Northern Pacific; Chicago, Burlington & Quincy.

Railroad stations and estimated population January 1, 1916: Huntley, 175; Osborn;[1] Worden, 114; Newton;[1] Pompeys Pillar, 47; Bull Mountain;[1] Ballantine, 120; and Anita,[1] Mont.

WATER SUPPLY.

Source of water supply: Yellowstone River.

Area of drainage basin: 12,000 square miles.

Annual run-off in acre-feet of Yellowstone River at Huntley (12,000 square miles), 1908 to 1915: Maximum, 7,391,600; minimum, 4,562,220; mean, 6,014,000.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916: 32,905 acres.

Area under water-right applications, season of 1916: 26,711 acres.

Length of irrigating season: May 1 to September 30—153 days.

Average elevation of irrigable area: 3,000 feet above sea level.

Rainfall on irrigable area: 9 years, average, 14 inches; 1915, 17.23 inches.

Range of temperature on irrigable area: —35° to 100° F.

Character of soil of irrigable area: Ranges from heavy clay to light sandy loam.

Principal products: Alfalfa, oats, sugar beets, and wheat.

Principal markets: Billings, Mont.; St. Paul and Minneapolis, Minn.; Denver, Colo.; Kansas City, Mo.; Seattle, Wash.

LANDS OPENED FOR IRRIGATION.

Dates of public notices and orders: May 21, 1907; March 3, 1909; March 13, 1912; June 23, August 9, 1913; September 24, November 3, 1914; February 27, March 20, October 9, December 23, 1915; January 15, March 15, 1916.

Location of lands opened: Tps. 2 and 3 N., Rs. 27 to 31 E., inclusive, M. M.

Present status of irrigable lands opened: 25,799.84 acres entered subject to the reclamation act, 3,107.56 acres open to entry; 3,997.40 acres in private ownership.

Limit of area of farm units: 160 acres.

Duty of water: 2½ acre-feet per acre per annum at the farm.

Building charge per acre of irrigable land: First unit, entered before December 23, 1915, public land, $30 per acre, additional charge of $4 per acre payable to Indians; private land, $50 per acre since December 1, 1913, additional charge of $15 per acre for supplemental construction for all water-right applicants subject to the terms of the extension act; and all other water-right applicants who have agreed to the increased charge; public land entered since December 23, 1915, $45 per acre. Second and third units, public land, $60 per acre, additional charge of $4 per acre payable to Indians; private land, $60 per acre.

Annual operation and maintenance chage: A minimum charge of $1 per acre of irrigable land, which entitles the water user to 1 acre-foot of water per acre, and additional water furnished at the rate of 50 cents per acre-foot; water-right applicants in the first unit who failed or refused to sign the contract for payment of the supplemental construction charge; $1.50 per acre of irrigable land in addition to the above water charge.

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[1] Less than 25 population.

CHRONOLOGICAL SUMMARY.

Reconnoissance made and preliminary surveys begun in 1904.
Construction recommended by board of engineers February 26, 1905.
Construction authorized by Secretary April 18, 1905.
First irrigation by Reclamation Service, season 1908.
First unit completed in 1908.
Second unit completed in 1915.
Entire project 83.9 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Huntley project provides for the diversion of water from the south side of the Yellowstone River about 2 miles above Huntley, Mont., into a main canal which extends down the valley about 27 miles to a point 2 miles east of Bull Mountain. The greater portion of the water is distributed by gravity. Fourteen miles below the head gates a pumping plant is installed, and a small portion of the water is lifted 45 feet into a high-line canal. The high-line canal serves about 5,400 acres of land above the main canal in the vicinity of Ballantine, Anita, and Pompeys Pillar. The pumping plant is a reinforced concrete building containing two pumping units, each with a capacity of about 31 second-feet and each comprising a turbine water wheel directly connected with a centrifugal pump by means of a vertical shaft. Three hundred and ten net horsepower is developed by a 34-foot drop in the main canal.

It will be necessary to provide for an additional water supply for lands under the high-line canal during the fiscal year 1917. To meet this requirement it is proposed to construct an auxiliary pumping station on the main canal near the present pumping plant for lifting water from the main canal into the high-line canal, which will require the enlarging of the high-line canal, or construct a gravity canal from the first drop on the main canal to the intake of the reservoir-line canal. This construction will serve about 2,100 acres now lying under the high-line canal. The proposed pumping plant will obtain power either by means of an independent steam or gas plant, purchase of power from the Montana Power Co., or by power developed by the construction of a hydroelectric plant at the second drop in the main canal, located about 3 miles below the proposed pumping site.

During the present season the entire system is being utilized for irrigating purposes.

The United States claims all waste and percolating waters arising within the project, and proposes to use such waters in connection therewith.

Future operations include the construction of drainage canals for the relief and protection of project lands from seepage conditions, the replacing of all remaining timber structures in the first unit with permanent type structures, and the construction of necessary works to increase the water supply for lands under the high line canal.

SUMMARY OF GENERAL DATA FOR HUNTLEY PROJECT, TO JUNE 30, 1916.

Areas:	
Irrigible acreage when project is complete	32,905.00
Public land entered June 30, 1916	25,800.00
Public land open to entry June 30, 1916	3,107.00
Private land June 30, 1916	3,908.00
Acreage service could have supplied season of 1915	30,826.00
Addition in fiscal year 1916	2,079.00
Estimated acreage service can supply July 1, 1917	32,905.00
Acreage actually irrigated season of 1915	18,203.00
Acreage cropped under irrigation season of 1915	18,183.00

Crops:			
Value of irrigated crops season of 1915			$535, 363. 00
Value of irrigated crops per acre cropped			$29. 41
Finances:			
Estimated cost of completed project			$1, 755, 348. 00
Total construction cost to June 30, 1916			$1, 472, 862. 44
Per cent complete June 30, 1916			83. 9
Appropriation for fiscal year 1917, total			$160, 000. 00
Allotment for construction fiscal year 1917			$102, 000. 00
Estimated per cent complete June 30, 1917			89. 7
Announced construction charges per acre			$30, $45, $50, $60
Appropriation fiscal year 1916		$150, 000. 00	
Increase under 10 per cent provision of act		4, 000. 00	
Total appropriation			$154, 000. 00
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$119, 054. 04		
Transfers	7, 467. 82		
		$126, 521. 86	
Registered liabilities chargeable to 1916 appropriation		16, 042. 57	
			$142, 564. 43
Unencumbered balance July 1, 1916			$11, 435. 57
Repayments:			
Construction charges—			
Accrued to June 30, 1916			$269, 719. 61
Collected to June 30, 1916			$264, 394. 82
Uncollected June 30, 1916			$5, 324. 79
Operation and maintenance charges (public notice)—			
Accrued to June 30, 1916			$122, 465. 60
Collected to June 30, 1916			$114, 786. 77
Uncollected June 30, 1916			$7, 678. 83
Water rental charges—			
Accrued to June 30, 1916			$344. 46
Collected to June 30, 1916			$281. 62
Uncollected June 30, 1916			$62. 84
Drainage:			
Estimated acreage damaged by seepage to June 30, 1916			2, 000
Miles of drains built to June 30, 1916:			
Open		11. 57	
Closed		38. 02	
Total			49. 59
Estimated acreage protected by drains built to June 30, 1916			17, 000
Estimated acreage to be protected by authorized system			24, 000
Expended, to June 30, 1916, on drainage works, completed and uncompleted			$382, 888. 59

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

MAIN AND HIGH LINE CANALS.

The Huntley Main Canal, with a capacity of 400 second-feet at the intake heads on the south side of Yellowstone River about 2 miles above Huntley, Mont., and extends northeast a distance of about 30 miles, diverging not more than 4 miles from the river channel. Division 1 extends from Yellowstone River along the bluffs south of the river to station 126, a distance of about 2.2 miles.

Proposals for the construction of division 1 of the main canal were opened on June 28, 1905, but the successful bidders refused to undertake the construction. The work was again advertised, the original plans having been changed to include an additional length of tunnels. Proposals were opened and a contract for the work was awarded on January 15, 1906. Excavation was begun in March, 1906, but was carried on slowly. The tunnels were completed on May 26, 1907, and the final work on the contract was completed on January 15, 1908.

Division 2 of the main canal follows the general direction of the Chicago, Burlington & Quincy Railroad eastward to within 3 miles of Ballantine. The first three-fourths of a mile on this division is in thorough cut from 8 to 17 feet deep, and the remainder is located approximately on the economic contour. The location of the canal crosses the original channel of Pryor Creek eight times, and to avoid danger from the waters of this stream a new channel for the creek was cut to carry the water over the main canal in a direct line 1,500 feet in length to Yellowstone River. Proposals were opened June 28, 1905. The successful bidders refused to execute contracts and a second award for the construction of division 2 was made on November 6, 1905. During the winter of 1905–6 the contractor erected an Armstrong steam excavator, with which work was begun on the upper end of the division in April, 1906. Excavation with scrapers and teams was begun at about the same time, and the work was completed on May 1, 1907. Work on the new Pryor Creek channel, which was included in the contract, was begun about April 1, 1906, and continued to June 22, 1906. A needle dam was then built, and the creek was turned into the new channel on June 15, 1906.

Division 3 of the main canal extends from about 3 miles west of Ballantine eastward along the general course of the Chicago, Burlington & Quincy Railroad to 1 mile northeast of Ballantine, where are located a 34-foot drop and a power plant which develops power for pumping about 56 second-feet of water from the main canal into a high-line canal. From the pumping plant the main canal continues in a northeasterly direction for about 10 miles to Lost Boy Creek, near the town of Pompeys Pillar. The high-line canal, which is also included in division 3, is about 7 miles long and extends easterly from the pumping plant. Proposals were opened June 28, 1905, and the successful bidders refusing to execute contracts, a second award was made for the construction of division 3. The contractors, however, failed to begin work within a reasonable time, and the contract was suspended and the work readvertised. Proposals were opened on June 20, 1906, and a contract was awarded soon after that date. Work was begun by the contractor on August 1, 1906, and was continued in a satisfactory manner to completion in December, 1907.

The pumping station, gates and guides for the headworks and wasteways on division 1, all concrete structures on divisions 2 and 3 of the main canal, together with two steel highway bridges and 120,000 pounds of steel for concrete reinforcement, were included in proposals opened on June 28, 1905. A contract was executed soon after the opening of proposals, and the work was commenced in October, 1905. Changes in design of the power plant made it advisable to draw new plans for this structure and to request new proposals for its construction. The remainder of the work under the structures contract was carried on satisfactorily and was completed June 1, 1907.

Extension of main and high-line canals.—To bring all of the lands within the project under irrigation it was necessary to extend the main and high-line canals and construct a lateral system thereunder, opening to entry the second and third units.

The second unit, containing 1,852.80 acres of irrigable land, lies under the extension of the main canal. The third unit, containing 2,079 acres of irrigable land, lies under the extension of the high-line canal.

Surveys for the extension of the main and high-line canals were begun in August, 1910, and were continued during the spring and summer of 1911. On May 25, 1911, a board of engineers consisting of H. N. Savage, W. H. Sanders, C. P. Williams, and C. D. Howe, recommended to the director that the extension be constructed and that advertisement of the work be made at the earliest practicable date. Specifications No. 193 were prepared and advertisement made July 25, 1911. On September 1, 1911, bids were opened at Huntley, Mont., by a board of engineers consisting of H. N. Savage, W. H. Sanders, and C. D. Howe; eight bids were received. Mr. J. E. Hilton was low bidder on schedules 1 to 6, inclusive. Mr. J. S. Hilend was low bidder on schedule 7. Two unsatisfactory bids were received on schedule 8 and all bids on this schedule were rejected. On October 21, 1911, contract No. 410, earthwork, was awarded to J. E. Hilton, and on October 10, 1911, contract No. 413, structures, was awarded to J. S. Hilend.

Construction work under contracts Nos. 410 and 413 was begun in October and November, 1911, and the work completed on June 22 and July 27, 1912, respectively. The specifications provided that the work should be completed on or before June 1, 1912, and owing to the failure of the contractors completing the work on time liquidated damages covering engineering expense after June 1 were deducted from the final estimates. The final contract claim, contract No. 410, amounted to $34,670.59; contract No. 413 amounted to $29,699.27. The total cost to the United States for work performed under these contracts amounted to $85,526.43.

On July 1, 1912, a severe storm occurred. Hail and rain fell for a period of 45 minutes. During this period 5¾ inches of water fell in a washtub. As a result of the storm the canal embankments in many places were washed away, a number of the principal structures were wrecked, and a large number of the smaller structures were washed out. All structures suffered some damage. New structures were designed to replace those destroyed by the storm. Damages to structures for which new designs were not made were repaired by the structural contractor. On August 9 Government forces were organized to repair the flood damages to earthwork and replace structures destroyed by the storm. This work was completed June 6, 1913. A small crew during the summer was employed priming canals and cleaning gravel out of cross drainage culverts.

On May 13, 1912, a contract was entered into with the Northern Pacific Railway Co. covering the construction of lateral crossings underneath the company's tracks. Work was started on these structures in May, 1913, and was completed in January, 1914. The total cost to the United States for performing this work amounted to $4,968.74.

During November and December, 1914, the work included in schedule 8, Specifications 193, was accomplished by Government forces.

The laterals constructed on this extension were in most instances much steeper than the soil could stand without serious washing. It was necessary that these grades be reduced and that some new ditches be built to irrigate farm units not taken care of by the system as constructed. Repairs were also made on constructed canals and laterals. This construction work was begun with Government forces May 18, 1915, and completed on July 17, 1915.

The extension to the high-line canal was not operated for two years after it had been constructed, consequently a good deal of sediment during that time was washed into the canal from surface run-off. In May and June, 1916, the sediment was removed by Government forces.

The total expenditure on canal extension account work accomplished by United States forces amounted to approximately $70,349.20.

DISTRIBUTION SYSTEM.

The distribution system of the Huntley project consists of about 268 miles of laterals and sublaterals. Proposals for the excavation and structures on this system were opened on December 15, 1905, and a contract was executed on January 2, 1906. Work was begun by the contractors early in January, 1906. The bids were made just previous to a great increase in the cost of construction work, and the contractors lost heavily in consequence. On November 16, 1906, satisfactory progress not having been made, the contract was suspended, and the work was continued by Government forces, being completed October 31, 1907.

The reinforcing and structural steel and the gates, guides, and lifting devices for the distribution system were furnished under a separate contract, the required material being delivered during the summer of 1906.

PUMPING PLANT.

The pumping plant is located about 1 mile east of Ballantine, where there is a fall of about 34 feet in the main canal. The plant contains two pumping units, each consisting of a vertical turbine actuating a 20-inch centrifugal pump mounted on the same shaft. The units work under a power head of 33½ feet and a pumping lift of 48½ feet, have a capacity of 28 second-feet each, and are practically automatic in operation.

Proposals for the construction of the pumping plant were opened on August 7, 1906. No formal proposal was received for schedule 1, embracing the construction of the reinforced-concrete building and pressure pipes, and the work under this schedule was executed by Government forces. The work was begun on October 23, 1906, and was completed on November 15, 1907. A contract was executed for schedule 2, including the pumping units, pipes, valves, and head gates, and the machinery was delivered July 8, 1907. Tests made in September, 1908, July, 1909, and October, 1909, were unsatisfactory, but after changes a satisfactory test was made July 13, 1910.

TELEPHONE SYSTEM.

The telephone system of the Huntley project consists of 22.7 miles of two-wire, metallic-circuit line. Proposals for the construction of the telephone system were opened on December 15, 1905. The contract for the work was awarded soon after this date and the installation of the system was completed on May 20, 1906.

CONSTRUCTION DURING FISCAL YEAR.

First unit.—Closed drains Nos. 13, 19, and 21, aggregating 51,351 linear feet, and open drains Nos. 10, 16, 19, and 162, aggregating 28,350 linear feet, were constructed. In addition, 5,380 linear feet wooden cunette were placed in open drain No. 7; 2 wooden bridges and 2 wooden flumes were placed over open drain 16; 1 wooden bridge was constructed over open drain 162; and concrete paving placed in open drains 10 and 16 under the Northern Pacific Railway bridges Nos. 524 and 535, respectively.

On the canal system 4 wooden checks and 8 wooden turnouts were replaced with concrete structures. On the lateral system the following wooden structures were replaced with concrete structures: 4 drops, 8 checks, 4 turnouts, 10 combination structures, 1 culvert, and 1 flume. The estimated cost of this construction over and above replacement in kind was charged to supplemental construction, and the remainder of the cost to operation and maintenance. There were 617 timber measuring devices installed under supplemental construction.

Third unit.—On the extension of the high line canal one chute drop was placed in lateral HR-5. Repairs were made to flumes, several structures were backfilled, a number of ditch banks were raised, and the entire length of the reservoir line canal was cleaned of sediment which varied in depth from 0.1 to 2.5 feet.

All construction work accomplished during the fiscal year 1916 was performed with United States forces.

SEEPAGE AND DRAINAGE.

Seepage first appeared on the project, first unit, at several different locations in 1910. These areas increased in size and new areas appeared during the season 1911. Steps were taken in 1911 to investigate underground conditions with a view to locating closed drains for reclaiming the areas. In 1912 seepage had gained rapidly, and it was decided to carry on extensive investigations over the first unit to determine the elevation of the ground water and character of subsoil material as an aid in planning drainage work for the relief of the land. At the close of the year 1914 the investigations had been completed over an area of 23,800 acres. These investigations showed that nearly all of the first unit, except where the land was protected by drainage works constructed since 1911, was seeped or threatened with seepage. At the close of the fiscal year 1916 about 2,000 acres of land were unfit for crop production owing to seepage.

In 1912 construction work on drains for the relief and protection of project lands from waterlogged conditions was started, and construction work has been carried on since that time as rapidly as possible with the funds made available. At the end of the fiscal year 38.02 miles of closed drains and 11.57 miles of open drains had been constructed. The drainage works constructed have reclaimed and protected a large portion of the project lands lying within the first unit.

Seepage has shown up on one small area on the second unit of the project during the current season. As far as known no indications of seepage have appeared on the third unit of the project.

OPERATION AND MAINTENANCE.

The operating season of 1915 opened April 28 and closed September 26. The months of May, June, and July were cool and had an abnormal rainfall, thus making water requirements light. August and September were the hottest and driest months of the season, and the greater part of the year's irrigation work was performed during those two months. The entire canal system, comprising 210 miles of canals and the pumping plant, serving the first and second units of the project, were in operation during the calendar year 1915.

The precipitation during 1916 has been below normal, and irrigation requirements have been comparatively large.

In the spring of 1916 operation was resumed on the entire canal system, comprising 227 miles of canals, and the pumping plant, serving the first, second, and third units of the project.

During both 1915 and 1916 an attempt has been made to deliver water under a four-day rotation system providing for a continuous flow in the laterals and the rotation of alternate farm units. However, weather and crop conditions have made it necessary at times to deviate materially from the prearranged water schedule.

Maintenance work was confined to repairs to canals and structures, mowing weeds, cleaning sediment from canals, replacing timber structures with permanent ones, and maintaining constructed closed drains.

Historical review, Huntley project.

Item.	1911	1912	1913	1914	1915	1916[1]
Acreage for which service was prepared to deliver water	28,805	28,805	28,805	28,805	30,826	32,905
Acreage irrigated	12,000	14,425	15,7[illegible]8	17,068	18,203	19,500
Miles of canal operated	175	194	194	194	210	227
Water diverted (acre-feet)	48,788	46,994	54,702	55,543	52,383	60,000
Water delivered to land (acre-feet)	22,550	21,437	24,118	24,429	17,634	29,250
Per acre of land irrigated (acre-feet)	1.88	1.50	1.53	1.43	0.97	1.50

[1] Estimated.

SETTLEMENT.

During the fiscal year there were 23 new filings. Five farms changed hands by relinquishment and 11 farms changed hands by assignment and transfer.

Two town lots—one at Ballantine and one at Osborn—were sold. The residential districts of Ballantine and Worden town sites made substantial gains in the number of buildings erected.

On November 3, 1915, 46 farm units in the third unit were opened to homestead entry, and at the close of the fiscal year 22 of the units had been filed upon.

Farmers in the vicinity of Ballantine cooperated in the construction of a cheese factory which was put in operation during the year. The Ballantine State Bank financed the project, and to further aid in its success purchased 2 carloads of Holstein cows and heifers, selling them to the farmers on terms.

Settlement data, Huntley project.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	585	585	586	646	691
Population	1,420	1,659	1,700	1,754	2,050
Number of irrigated farms	480	527	535	530	550
Operated by owners or managers			432	383	400
Operated by tenants			103	147	150
Population	1,420	1,659	1,700	1,754	2,050
Number of towns	8	8	8	8	8
Population	325	350	475	475	468
Total population in towns and on farms	1,745	2,009	2,175	2,229	2,518
Number of public schools	13	13	14	15	8
Number of churches	5	5	6	6	6
Number of banks	2	2	3	3	3
Total capital stock	$40,000	$40,000	$60,000	$60,000	$60,000
Total amount of deposits			$220,000	$239,000	$307,414
Total number of depositors			886	1,060	1,180
Number of relinquishments	27	16	4	2	5

PRINCIPAL CROPS.

The principal crops in 1915 were sugar beets, alfalfa, wheat, and oats, in the order named. These crops represented 88 per cent of the total cropped area and returned 92 per cent of the total estimated crop value for the season. The showing made was the best in the history of the project.

The season of 1916 promises to be an average year. There are approximately 1,800 acres more land under irrigation than ever before. The crops at the end of the fiscal year were not quite so far advanced as they were the previous year.

Crop report, Huntley project, Montana, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	5,287	Tons	15,010	2.82	$5.76	$86,458	$16.35
Alfalfa seed	2	Bushels	3	1.50	9.57	29	14.50
Barley	415	...do	8,196	19.75	.53	4,344	10.47
Beans	4	...do	49	12.25	2.14	105	26.25
Beets	5,402	Tons	53,911	9.98	5.92	319,153	59.08
Corn	509	Bushels	9,258	18.19	.80	7,406	14.55
Corn fodder	18	Tons	55	3.06	3.19	175	9.72
Hay	440	...do	568	1.29	9.48	5,385	12.24
Orchard	10	Pounds	9,060	323.6	.025	227	22.70
Oats	2,514	Bushels	75,319	29.96	.49	36,906	14.68
Pasture	1,478					5,557	3.76
Peas	4	Bushels	32	8	.75	24	6.00
Potatoes	80	...do	9,360	117	.72	6,739	84.24
Rye	11	...do	220	20	.50	110	10.00
Spelt	18	...do	521	28.94	.43	224	12.44
Truck	234					13,050	55.77
Wheat	2,869	Bushels	56,863	19.82	.87	49,471	17.24
Less duplicated areas	1,110						
Total cropped acreage	18,183	Total and average				535,363	29.41

Irrigated; no crop:	
Nonbearing orchard	18
Total irrigated acreage	18,203

Areas.	Acres.	Farms.	Per cent of project.
Farms reported	23,791	530	72.3
Irrigated under water-right applications.	18,203	530	55.4
Cropped	18,183	530	55.4

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, OCTOBER 9, 1915.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplementary thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water will be furnished from the Huntley project, Montana, in the irrigation season of 1916 and each irrigation season thereafter, upon the filing of proper water-right application for the irrigable lands in the third unit shown upon the following farm-unit plats, viz, Montana principal meridian, township 2 north, range 30 east, township 3 north, range 30 east, approved October 2, 1915, by the Secretary of the Interior and on file in the office of the project manager, United States Reclamation Service, Huntley, Mont., and of the local land office at Billings, Mont.

2. Homestead entries of the farm units shown on said plats embracing public lands of the United States may be made on and after November 3, 1915, at 9 o'clock a. m., at the local land office, Billings, Mont., if found regular and accompanied by the certificate of the project manager, showing that water-right application has been filed and proper water-right charges deposited.

3. Warning is hereby expressly given that no person will be permitted to gain or exercise any right whatever under any settlement or occupation begun prior to 9 a. m., November 3, 1915, on any lands

shown on said plats, provided, however, that this shall not interfere with any valid existing rights obtained by settlement or entry while the land was subject thereto. All persons desiring to acquire any public lands shown on said plats shall execute homestead application subject to the provisions of the reclamation act in the manner required by law, which, with the required fees and commissions, accompanied by certificate of the project manager as to the filing of water-right application and payment of water-right charges as hereinafter provided, shall be presented to the local land office at Billings, Mont., in person, by mail or otherwise, within a period of five days prior to November 3, 1915; that is, beginning not earlier than October 29, 1915. All entries filed as herein provided and reaching the local land office not later than 9 a. m. on November 3, 1915, shall be held and treated as simultaneously filed. Applications presented after that hour will be received and noted in the order of filing. Any application not based on a prior settlement right will be subject to valid settlement claims asserted in the manner required by law.

4. The register and receiver will carefully compare all applications simultaneously filed as aforesaid and will dispose of them as follows:

(*a*) Where there is no conflict the application shall be allowed, irrespective of whether settlement is alleged.

(*b*) In case of conflicting applications and only one of the applicants alleges prior settlement, his application shall be allowed and the others rejected.

(*c*) If two or more conflicting applications are received, each containing allegations of prior settlement, a hearing shall be ordered to determine the priority of right, and it shall be restricted to those alleging such right.

5. Where there are applications conflicting in whole or in part in which no one of the several applicants claims prior settlement, the register and receiver will write on cards the names of the several applicants, and each of these cards shall be placed in an envelope upon which there is no distinctive or identifying mark, and at 2 o'clock p. m. on the date of opening to entry, if practicable (if not, at the same hour one week later), after all the envelopes containing the names of the several applicants shall have been thoroughly mixed in the presence of such persons as may desire to be present, they shall be drawn and numbered in order. The cards as numbered and drawn will be securely fastened to the applications of the respective persons, and the applications shall be allowed in such order. Where any applicant fails to obtain land applied for by him he will be permitted to elect whether he will amend his application to embrace other lands not affected by pending applications and otherwise subject thereto when such amended application is presented, or withdraw his original application without prejudice, and in the event of such withdrawal the fee and commissions will be returned by the receiver and the water-right charges deposited will be returned by the project manager. Applications conflicting in whole with those previously allowed will be rejected in the usual manner.

6. The project manager will receive water-right applications accompanied by the proper water-right payments, which for the first payment from homestead entrymen, under paragraphs 3, 4, and 5 hereof, will be accepted in the form of drafts on New York or Denver or money order, etc., payable to the chief clerk, United States Reclama-

tion Service, Huntley, Mont., and issue certificates to applicants for public lands at any time after the date of this notice. Each application must be for a specific farm unit. More than one person may make water-right application for the same farm unit. Filing of water-right application and issuance of certificate gives no preference right to make entry. Acceptance of the application will be indorsed thereon by the project manager when notified by the local land office that entry has been allowed. All other applications, with payments made, will be returned to applicants upon surrender by them of the certificate of filing issued by the project manager.

7. The limit of arēa per entry representing the acreage which, in the opinion of the Secretary of the Interior, may be reasonably required for the support of a family upon such lands is fixed at the amounts shown upon the plats for the several farm units. The maximum limit of area for which water-right application may be made for lands in private ownership shall be 160 acres of irrigable land for each landowner. Water-right applications for lands in private ownership may be made on and after the date of this notice. All water-right applications, whether for public or private lands, must be made to the project manager, United States Reclamation Service, Huntley, Mont.

8. The charges per acre of irrigable land upon said entries and upon all other lands in said third unit shown upon said plats are of two kinds, namely: (*a*) A charge of $60 per acre for the building of the irrigation system, termed the construction charge; (*b*) an annual charge for operation and maintenance due March 1 of each year. In addition there will be for all homestead entries a charge of $4 for each acre of land included within the entry, whether irrigable or not, to cover the Indian price of the land. Each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge which shall be the charge for 1 acre-foot of water.

9. An initial payment of $3 per irrigable acre on account of the construction charge and $1 per acre on account of the Indian cost of the land, shall be made at the time of making water-right application or entry of a farm unit. The remainder of the construction charge, $57 per irrigable acre, shall be paid in 15 annual installments, the first 5 of which shall be $3 each and the remainder $4.20 each. The first of the said annual installments shall become due and payable on December 1 of the fifth calendar year after the initial installment, and subsequent installments shall become due on December 1 of each calendar year thereafter. Any water-right applicant may, if he so elects, pay the whole or any part of the construction charges owing by him within a shorter period. The balance of the payment on account of the Indian cost of the land shall be made in four equal annual installments, the first of which shall be due on December 1 of the year following the date of entry.

10. All water-right charges must be paid at the office of the United States Reclamation Service at Denver, Colo., except as provided in paragraph 6. Drafts on New York or Denver or money orders, etc., should be made payable to the disbursing officer, United States Reclamation Service, Denver, Colo.

11. In all cases where application for water right for lands in private ownership or lands held under entries not subject to the recla-

mation law shall not be made within one year after the date of this notice, the construction charges for such land shall be increased 5 per cent each year until such application is made and an initial installment is paid.

12. The operation-and-maintenance charge for the season of 1916 shall be based on the quantity of water delivered with a minimum charge per irrigable acre, whether water is used or not. The amount of such charge shall be hereafter announced and payment thereof will become due after the close of the irrigation season. The operation and maintenance charge for the irrigation season of 1916 will be due March 1, 1917. The method of determining the amount chargeable for operation and maintenance and the penalties for failure to pay the construction charges and the operation and maintenance charges when due are prescribed by act of Congress of August 13, 1914 (Public, No. 170).

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, DECEMBER 23, 1915.

1. Under the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof or supplementary thereto, particularly section 4 of the reclamation-extension act of August 13, 1914 (38 Stat., 686), it appears that a majority of the water-right applicants and entrymen in the first unit of the Huntley project who have accepted the terms of the reclamation-extension act, have made agreements providing for an increase in the cost of construction in the sum of $4 per irrigable acre for the replacement of timber structures with permanent type structures and additional permanent type structures in the canal system of said unit, and for an increase in the cost of construction in the sum of $11 per irrigable acre for the construction of drainage works for the relief and protection of lands under the said unit, a total increase in the charges of $15 per irrigable acre. The said agreements are hereby ratified and the said increase in the construction charge is hereby made effective in accordance with the conditions of the law and the said contracts as follows:

2. The construction charge of all water-right applicants and entrymen in the first unit of the Huntley project who have accepted the terms of the reclamation-extension act shall be increased $15 per irrigable acre.

3. With the exception hereinafter noted, the said increase of $4 per irrigable acre shall be paid in two additional annual installments of $2 each after the last of the regular installments payable under the terms of section 1 or section 2 of the reclamation-extension act, and the said increase of $11 per irrigable acre shall be paid after the last of such regular installments in five additional annual installments of $1.80 each and one final installment of $2 per irrigable acre. That is to say, after the last of the regular installments the additional installment will be $3.80 per irrigable acre for each of two years, then three installments of $1.80 each per irrigable acre and a final installment of $2 per irrigable acre, with the exception that in each case the annual payment after the last regular installment shall be at least equal to the amount of the largest installment previously

paid for said land and as fixed for the project by the public notices and orders heretofore issued and applicable to the land.

4. A construction charge of $45 per irrigable acre shall apply to all other land within the first unit of the Huntley project which becomes subject to the terms of the reclamation-extension act on or after the date hereof, whether described in water-right applications heretofore or hereafter made. The payments shall be made as provided in the sections of the reclamation-extension act applicable thereto.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, JANUARY 15, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and in particular the reclamation-extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, notice is hereby given that hereafter until further notice for all lands under the Huntley project, Montana, the operation and maintenance charge for any irrigation season shall be due and payable on March 1 of the following calendar year.

2. The operation and maintenance charges for the irrigation season of 1916 and for each irrigation season thereafter until further notice shall be due March 1 of the following year, and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of $1, which will permit delivery of not more than 1 acre-foot per acre, and should further quantities be needed they will be furnished at the rate of 50 cents per acre-foot.

3. The provisions of this public notice cover all lands subject to public notice heretofore issued for the said project.

4. Except as hereinabove provided, all the terms and provisions of existing public notices and orders, and in particular the public notice of February 27, 1915, for the Huntley project shall remain unchanged.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

ORDER, MARCH 15, 1916.

Whereas public notice was issued on December 23, 1915, under the provisions of the reclamation law, announcing a supplemental construction charge of $15 per irrigable acre, applicable to lands in the first unit of the Huntley project, Montana, for which acceptances of the provisions of the reclamation extension act of August 13, 1914, have been filed, such charge to cover the cost of drainage works, and also replacement of timber structures with permanent type structures, and additional permanent type structures in the canal system; and

Whereas such supplemental construction charge is, under the terms of the said reclamation extension act, applicable to all water-right applicants and entrymen in the area affected by such increased charge, who are subject to the reclamation extension act, because a majority of such water-right applicants and entrymen have made agreements with the Secretary of the Interior covering payment of such increased charge; and

Whereas the benefits of the work to be performed will accrue directly or indirectly to all water users in the first unit of the project: Now, therefore,

It is hereby ordered, That the following provisions shall affect all lands in said unit for which acceptances of the provisions of the said reclamation extension act have not been duly filed, viz:

1. For those who executed the contracts for payment of the supplemental charge such contracts are hereby accepted and the payment of the $15 per irrigable acre shall be made in seven annual installments of $2.10 each and a final installment of 30 cents per acre. The first of such installments shall be due on December 1 of the year following the due date of the last installment of the construction charge.

2. For those who failed or refused to sign the contract, the said supplemental charge of $15 per irrigable acre shall be added to the operation and maintenance charges in 10 equal annual installments of $1.50 each per irrigable acre, the first of which shall be due and payable on March 1, 1917.

3. For lands for which the entries or water-right applications have been or shall be canceled the construction charge shall be increased in the sum of $15 per irrigable acre whenever the lands are again entered and water-right applications are made therefor, under the provisions of the public notice of December 23, 1915.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[Financial statements in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 708.]

Feature costs of Huntley project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys		$5,350.71
Canal system		689,549.97
Lateral system		360,277.93
Drainage system		382,888.59
Flood protection		3,731.03
Power system		82.14
Farm units		1,751.99
Permanent improvements and land		18,336.13
Telephone system		9,112.34
Plant accounts		19,330.78
Operation and maintenance charges transferred to and compounded with construction charges		1,781.61
Gross cost of construction of project to June 30, 1916		1,492,193.22
Less revenues earned during construction period:		
Rental of buildings	$315.00	
Rental of grazing and farming land	1,100.69	
Rentals of telephones and tolls	406.79	
Contractors' freight refunds	7,633.45	
Sale of town-site lots	37,544.72	
Other revenues, unclassified	212.00	
Profit on hospital operations	2,825.65	
		50,038.30
Net cost of construction of project to June 30, 1916		1,442,154.92

Estimated cost of contemplated work of Huntley project during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examination and surveys		$850.00
Canal system		4,000.00
Lateral system		41,150.00
Drainage system		88,000.00
Operation and maintenance under public notice		26,000.00
Total		160,000.00

MONTANA, MILK RIVER PROJECT.

W. W. SCHLECHT, project manager, Malta, Mont.
J. B. BOND, project manager St. Mary storage unit, Browning, Mont.

LOCATION.

Counties: Teton, Hill, Blaine, Phillips, and Valley.

Townships: 34 to 37 N., R. 14 W.; 34 N., R. 15 W.; 37 N., Rs. 11 to 13 W.; 33 to 37 N., Rs. 10 to 13 E.; 27 to 33 N., Rs. 17 to 42 E., Montana meridian.

Railroads: Great Northern and Canadian Pacific.

Railroad stations and estimated population January 1, 1916: Browning; Havre, 5,500; Chinook, 1,500; Harlem, 700; Savoy, 80; Coburg, 60; Dodson, 400; Wagner, 60; Malta, 1,100; Saco, 750; Hinsdale, 600; Glasgow, 2,500; and Nashua, Mont., 350; Cardston and Woolford, Canada.

WATER SUPPLY.

Source of water supply: St. Mary Lakes, Swift Current Creek, and Milk River.

Area of drainage basin: St. Mary Lakes and Swift Current Creek, 298 square miles; Milk River at Havre, 5,550 square miles; Milk River at Malta, 11,850 square miles; Milk River at Hinsdale, 20,150 square miles.

Annual run-off in acre-feet of St. Mary River (including Swift Current Creek): At Babb (298 square miles), 1902–1915—maximum, 830,000; minimum, 459,250; mean, 555,700. At international line (452 square miles), 1903–1915—maximum 1,107,300; minimum, 514,100; mean, 710,300. Of Milk River: At Havre (5,550 square miles) 1898–1915—maximum, 426,000; minimum, 17,100; mean, 213,500. At Malta (11,850 square miles), 1903–1915—maximum, 647,000; minimum, 29,400; mean, 300,800. At Hinsdale (20,150 square miles), 1908–1914—maximum, 1,210,000; minimum, 146,500; mean, 549,800.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season 1916: 45,000 acres.

Area under rental contracts, season 1916 (to June 30): 4,460 acres.

Length of irrigation season: From April 15 to October 1, 170 days.

Average elevation of St. Mary storage: 5,500 feet above sea level.

Average elevation of irrigable area: 2.200 feet above sea level.

Rainfall on St. Mary storage: About 24 inches, average.

Rainfall on irrigable area: At Havre, 36 years, average 13.67 inches; 1915, 14.22 inches; at Malta, 10 years, average 13.84 inches; 1915, 16.03 inches.

Range of temperature on irrigable area, —56° to 103° F.

Character of soil of irrigable area: Sandy loam, clayey loam, and some gumbo.

Principal products: Alfalfa and other fodder crops, grain, and vegetables.

Principal markets: Minneapolis and St. Paul, Minn., Great Falls, Mont., and local.

LANDS OPENED FOR IRRIGATION.

No lands have been opened for irrigation by public notice. The irrigated area under rental contracts during 1911 was 2,074 acres; during 1912, 353 acres; during 1913, 2,545 acres; during 1914, 2,201 acres; during 1915, 4,192 acres; and during 1916, to June 30, 4,460 acres.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys begun by the Reclamation Service in 1902.

Construction recommended by director March 7, 1903.

Construction conditionally authorized by Secretary March 14, 1903.

Construction of St. Mary storage unit recommended by board of engineers September 19, 1904.

Construction of St. Mary storage unit authorized by Secretary March 25, 1905.

Construction begun July 27, 1906.

Dodson diversion dam completed in January, 1910.

Treaty with Great Britain relating to distribution between Canada and the United States of the waters of St. Mary and Milk Rivers signed January 11, 1909, and proclaimed May 13, 1910.

Water delivered for irrigation in 1911.

Recommendations covering construction of the project approved by Secretary June 13, 1912.

Dodson North Canal completed in 1914.

Sherburne Lakes Reservoir begun June 29, 1914.

Vandalia diversion, Vandalia South, and Dodson South Canals completed in 1915.

Nelson Reservoir, first development completed 1915.

Nelson Reservoir South Canal begun 1915.

Bowdoin Canal begun 1915.

Milk River unit 54 per cent completed June 30, 1916.

St. Mary storage unit 71 per cent completed June 30, 1916.

Entire project 59 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Milk River project provides for the storage of water in the Sherburne Lakes and the St. Mary Lakes, and its diversion thtrough a canal 28.9 miles long, heading three-fourths of a mile below St. Mary Reservoir and discharging into the North Fork of Milk River, thence flowing through Canada for 100 miles or more and returning to the United States; the storage of water in Nelson Reservoir south of Milk River and 14 miles northeast of Malta; the discharge of stored water into Milk River as required; the diversion of water from Milk River by a dam near Chinook into two canals, one on each side of the river, for the irrigation of lands near Chinook and Harlem, comprising the Chinook division; the diversion of water from Milk River by a dam near Dodson into two canals, the northside canal irrigating lands near Dodson, Wagner, and Malta, and the southside canal conveying water to Nelson Reservoir and irrigating lands near Wagner, Malta, Bowdoin, and Ashfield; the irrigation of lands on both sides of Milk River and Beaver Creek in the vicinity of Saco and Hinsdale from the stored waters of Nelson Reservoir, comprising the Malta division; and in the Glasgow division the diversion of water at Vandalia Dam into a canal on the south side of Milk River for the irrigation of lands near Tampico, Glasgow, and Nashua. In case the normal flow of Milk River at Vandalia Dam is not sufficient for the irrigation of lands in the Glasgow division, the stored waters in Nelson Reservoir will be returned to Milk River and diverted again at Vandalia Dam. The United States claims all waste, seepage, spring, and percolating water arising within the project, and proposes to use such water in connection therewith.

The features of the above irrigation plan which have been completed are: 28.9 miles of the St. Mary Canal, the Dodson and Vandalia diversion dams to the height of the fixed crest; headworks for the Dodson North, Dodson South, and Vandalia South Canals; 10 miles of the Dodson South Canal, with a capacity of 900 second-feet, including Point of Rocks equalizing reservoir, 34 miles, with a capacity of 500 second-feet, and the lateral and waste-water systems to cover 15,000 acres; 28 miles of Dodson North Canal, with a capacity of 200 second-feet at its head, including the lateral and waste-water systems for 12,000 acres; 46 miles of Vandalia South Canal, with a capacity of 250 second-feet at its head, including the lateral and waste-water systems for 19,300 acres; and the first development of Nelson Reservoir to store 25,000 acre-feet.

The work under construction comprises the completion of railroad crossings on the Dodson South and Vandalia South Canals, the riprapping for the Dodson South Canal at Dodson Bridge, the drop from Nelson Reservoir to Milk River, the first unit of the Bowdoin Canal, and the Nelson Reservoir South Main Canal.

The principal features remaining to be completed are the St. Mary Lake and Sherburne Reservoirs; the second pipe line across St. Mary River and Halls Coulee Crossing; the second barrel of the steel flume across Spider Lake Coulee; and about 27 per cent of the structures; the Chinook division, comprising the diversion dam and the North and South Canals; Nelson Reservoir to its final development; Nelson Reservoir North and Ashfield Canals; second unit of the Bowdoin Canal; the lateral system for the Nelson Reservoir South Canal; and the permanent movable crest for the Dodson and Vandalia Dams.

SUMMARY OF GENERAL DATA FOR MILK RIVER PROJECT TO JUNE 30, 1916.

Areas:			
Irrigable acreage when project is complete			220,000
Public land entered June 30, 1916			46,000
Public land withdrawn June 30, 1916			25,900
State land June 30, 1916			9,300
Indian land June 30, 1916			30,000
Private land June 30, 1916			108,800
Acreage service could have supplied season of 1915			40,000
Addition in fiscal year 1916			5,000
Estimated addition in fiscal year 1917			19,000
Estimated acreage service can supply July 1, 1917			64,000
Acreage actually irrigated, season of 1915			4,192
Acreage cropped under irrigation, season of 1915			3,887
Acreage dry farmed and cropped, season of 1915			4,017
Crops:			
Value of irrigated crops, season of 1915			$51,249.00
Value of irrigated crops per acre cropped			$13.18
Value of crops dry farmed, season of 1915			$40,180.00
Value of crops dry farmed per acre cropped			$10.00
Finances:			
Estimated cost of completed project			$5,886,700.00
Total construction cost to June 30, 1916			$2,723,945.56
Per cent complete June 30, 1916			54
Appropriation for fiscal year 1917, total			$327,000.00
Allotment for construction, fiscal year 1917			$339,500.00
Estimated per cent complete June 30, 1917			56
Appropriation, fiscal year 1916			$611,000.00
Expenditures during fiscal year chargeable to 1916 appropriation:			
Disbursements	$192,856.98		
Transfers	16,114.10		
		$208,971.08	
Registered liabilities chargeable to 1916 appropriation		43,381.67	
Contract obligations wholly covered by 1916 appropriation		88,231.82	
Estimated engineering expenses on contract work wholly covered by 1916 appropriation		13,500.00	
			354,084.57
Unencumbered balance July 1, 1916			256,915.43
Repayments:			
Water rental charges—			
Accrued to June 30, 1916			$11,834.17
Collected to June 30, 1916			$10,139.37
Uncollected June 30, 1916			**$1,694.80**

ST. MARY STORAGE UNIT.

Finances:			
Estimated cost of completed project			$2,766,048.58
Total construction cost to June 30, 1916			$1,991,275.61
Per cent complete, June 30, 1916			71
Appropriation for fiscal year 1917, total			$369,000.00
Allotment for construction, fiscal year 1917			$292,300.00
Estimated per cent complete, June 30, 1917			83
Appropriation, fiscal year 1916			$489,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation:			
Disbursements	$390,778.91		
Transfers	24,480.01		
		$415,258.92	
Registered liabilities chargeable to 1916 appropriation		35,461.63	
Contract obligations wholly covered by 1916 appropriation		4,250.00	
			454,970.55
Unencumbered balance July 1, 1916			34,029.45

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

Milk River Project.

DODSON DIVERSION DAM.

The Dodson Diversion Dam is located 46 miles below the proposed Chinook diversion and 3 miles west of Dodson. The dam is a rock-filled timber crib, 19 feet high and 319 feet long, the downstream face of which is composed of 10-inch by 10-inch timbers protected by railroad rails. The abutments of the dam were also rock-filled timber cribs. Of these the south abutment was washed out during 1915 and was replaced with a concrete structure. On top of the dam concrete piers were built for a movable crest, which will add six feet to the height of the dam. The details of the permanent crest have not as yet been designed, but during the irrigation seasons of 1911–1916 temporary wooden needles were used. In connection with the construction of this dam it was necessary to raise the tracks of the Great Northern Railway for a distance of 4 miles and to protect the embankment from erosion by riprapping. In addition, it was necessary to purchase 2,425 acres of private and Indian lands for flowage rights.

On August 6, 1908, authority was given to construct the Dodson Dam with Government forces. Excavation was begun in September, 1908, and the dam was completed to the height of the fixed crest during the winter of 1909. The concrete piers for the movable crest were completed in January, 1910.

DODSON SOUTH CANAL.

The Dodson South Canal heads at Dodson Dam with a capacity of 900 second-feet and ends at Nelson Reservoir with a capacity of 500 second-feet; its length is 44 miles. In addition to being a feeder canal for Nelson Reservoir, it furnishes water for the irrigation of 42,500 acres, of which 26,000 are under its branch canals, the Ashfield and Bowdoin Canals. The headworks consist of a concrete structure with 15 openings 4 feet by 5 feet in size. The principal features of this system which have been completed are the Peoples Creek dikes and channels for the diversion of that creek so as to discharge above Dodson Dam, and also to protect private irrigation plants on the Fort Belknap Indian Reservation; the Point of Rocks equalizing reservoir, of 830 acre-feet capacity; the wasteway at and siphon across Alkali Creek, which consists of three lines of reinforced concrete pipe 7.5 feet in diameter; the headworks of Bowdoin Canal; the spillway into Lake Bowdoin; and the canal, lateral, and waste-water systems for the irrigation of 15,000 acres.

A portion of the main canal was excavated in 1908 and 1909 under the cooperative plan by contract with the water users' association. The remainder of the excavation for the first 9 miles was done by small contracts and a portion by Government forces. The structures and laterals for the irrigation of 7,800 acres were built by Government forces and were completed in June, 1910. The balance of the work on this canal system was built under the following contracts:

No. 462, with Winston Bros. Co., dated November 6, 1912, for earthwork on the main canal; schedule 4 of Specifications No. 220.

No. 464, with Charles Wilhite & Co., dated November 6, 1912, for earthwork, main canal; schedules 1, 2, and 3 of Specifications No. 220.

No. 515, with Charles Wilhite & Co., dated October 10, 1913, for earthwork on laterals; schedules 1 to 6 of Specifications No. 210.

No. 562, with Temple & Siroky, dated July 22, 1914, for earthwork on laterals; schedules 1 and 2 of Specifications No. 265.

No. 563, with the Security Bridge Co., dated July 23, 1914, for structures on the main canal and laterals; schedule 3 of Specifications No. 265.

No. 596, with the Security Bridge Co., dated November 25, 1914, for structures on the relocation at Dodson Bridge; schedule 2 of Specifications No. 281.

No. 603, with James O'Connor, dated December 1, 1914, for earthwork on the relocation at Dodson Bridge; schedule 1 of Specifications No. 281.

DODSON NORTH CANAL.

The Dodson North Canal heads at Dodson Dam with a capacity of 200 second-feet, and in a length of 29 miles irrigates 12,000 acres of land on the north side of Milk River between Dodson and a point 5 miles below Malta. The principal features of this canal system which have been built are the concrete headworks, containing four steel gates 4 by 4 feet in size; the siphon across Exeter Creek, which is a reinforced concrete pipe 5 feet 4 inches in diameter; and the canal, lateral, and waste-water systems for the irrigation of the land.

All work on this system, which was begun in 1912 and completed in 1914, was done under the following contracts:

No. 454, with J. S. Penson, dated June 14, 1912, for structures; schedule 6 of Specifications No. 209.

No. 455, with J. E. Hilton, dated June 21, 1912, for earthwork on the main canal and laterals of the first unit; schedules 1 to 5 of Specifications No. 209.

No. 476, with Tebbs & Taggart, dated December 21, 1912, for earthwork on the main canal; schedule 1 of Specifications No. 222.

No. 478, with J. E. Hilton, dated December 21, 1912, for earthwork on main canal; schedule 3 of Specifications No. 222.

With Buchanan & Co., by informal contract, for earthwork on main canal, schedule 2 of Specifications No. 222.

No. 509, with Heuser & Sim, dated August 30, 1913, for laterals and structures, second unit, schedules 1 to 3 of Specifications No. 241.

NELSON RESERVOIR.

Nelson Reservoir, located about 15 miles northeast from Malta, is a natural basin, the storage capacity of which is increased by building dams across depressions in the rim. At present these dams have been built to give a net storage capacity of 27,000 acre-feet, but as required they will be enlarged and raised by successive stages to give an ultimate capacity of 132,000 acre-feet. The reservoir is fed by Dodson South Canal, and the stored water will be used for the irrigation of about 50,000 acres under the Nelson Reservoir North and South Canals and, if required, for lands under the Vandalia South Canal, the stored water to be discharged into Milk River down a concrete pipe drop and again diverted at Vandalia Dam.

The work of the first development of the reservoir was done by contract No. 594 with the Security Bridge Co., dated November 20, 1914, and is covered by Specifications No. 282.

NELSON RESERVOIR SOUTH CANAL.

Nelson Reservoir South Canal, with a capacity of 260 second-feet, heads in Nelson Reservoir and will irrigate 22,000 acres of land in Beaver Creek Valley, near Ashfield, Saco, Beaverton, and Hinsdale. Work on this system was begun in June, 1915.

VANDALIA DIVERSION.

Vandalia diversion is 66 miles below the Dodson diversion. It consists of a reinforced concrete main overflow dam, with fixed crest at elevation 2116 and an automatic movable crest, by which the water can be raised an additional 6 feet. Two bridge piers, which will support steel bridges for the movable crest, divide the overflow of this dam into three 100-foot lengths. The abutments are reinforced concrete retaining walls having a maximum height of 51 feet. The entire structure is supported on piles and protected at the lower and upper edges by rows of sheet piling. Flanking the dam to the north there is an auxiliary spillway 4 feet high and 1,200 feet long, with crest at elevation 2123. This spillway is also built of reinforced concrete.

The construction of the dam was begun in May, 1913, by Government forces, and the structure, with the exception of the movable crest, was completed in June, 1915. During 1913 the south abutment and 90 feet of the foundation of the dam were built and the excavation and driving of piling for the north abutment was well under way. No serious difficulties were encountered, but since the excavation for the south abutment was 51 feet deep and numerous piles had to be driven, it was impracticable to begin the actual construction of the dam until late in the season. During 1914 the dam was completed with the exception of the deck for one of the bays and the placing of the sluice gates. During this year the work was delayed considerably by high water in Milk River, which occurred during practically every month. The excavation for the auxiliary spillway channels was done by contract No. 549, with James O'Connor, dated June 8, 1914, under Specifications No. 262. In connection with the building of the dam it was necessary to protect the Great Northern Railway embankment, and for this purpose 2,680 cubic yards of riprap were placed. Seven hundred and sixty-nine acres of land were purchased for flowage purposes.

VANDALIA SOUTH CANAL.

The Vandalia South Canal heads at Vandalia diversion with a capacity of 300 second-feet and irrigates 22,540 acres of land on the south side of Milk River between Vandalia and a point opposite Nashua. Headworks of this canal are located in the south abutment of the dam. The principal features of this system which have been built are the metal flumes, railroad culverts, concrete-lined sections at Vandalia Point, the reinforced concrete siphons across Antelope, Brazil, and Willow Creeks, and the canal, lateral, and waste-water systems for the irrigation of the land.

With the exception of the headworks, outlet conduit, and concrete-lined section adjacent to the dam, which were built by Government forces, this system was built under the following contracts:

No. 479 with Charles Wilhite & Co., dated January 10, 1913, for earthwork, main canal, schedule 2 of Specifications No. 226.

No. 480 with J. E. Hilton, dated January 17, 1913, for earthwork, main canal, schedules 1 and 3 of Specifications No. 226.

No. 524 with Threet Bros. & Jolley, dated December 15, 1913, for structures of the first unit, schedule 4 of Specifications No. 246.

No. 525 with Tebbs, Taggart, Jurgens & Knipe, dated December 20, 1913. for earthwork on the laterals of the first unit, schedules 1 to 3 of Specifications No. 246.

No. 551 with Threet Bros. & Jolley, dated June 27, 1914, for structures of the second unit, schedule 2 of Specifications No. 263.

No. 553 with W. J. Hoy Co., dated June 23, 1914, for structures at Vandalia Point, Specifications No. 264.

No. 566 with Tebbs, Taggart, Jurgens & Knipe, dated July 7, 1914, for earthwork on the laterals of the second unit, schedule 1, Specifications No. 263.

St. Mary Storage Unit.

ST. MARY CANAL.

On July 31, 1906, proposals were opened for the construction of the first 14 miles of the St. Mary Canal. One proposal was received, and the bid being considered excessive, was rejected. The construction of the canal by Government forces was then authorized. Orders were placed during 1906 for machinery. In the spring of 1907 the machinery was assembled, and excavation of the canal was begun. During 1911 the location of the canal from the headworks to St. Mary River crossing was changed on account of unstable material encountered. Contracts were awarded for the remainder of the St. Mary Canal and all of the structures. The contracts for the earthwork of schedules 1, 3, and 4 were awarded in July and August, 1913, and for the earthwork of schedules 2a and 21 and for the concrete structures in May and June, 1914; for the steel pressure pipes across St. Mary River and Halls Coulee in September, 1914; and for the highway and pipe-bridge across St. Mary River in March, 1915. All contract work was completed during the calendar year 1915.

SHERBURNE LAKES DAM AND RESERVOIR.

Surveys for the Sherburne Lakes Dam and Reservoir and foundation investigations for the dam were in progress during 1912 and 1913. The plans of the dam were approved and construction commenced in June, 1914. The dam will be an earthen embankment, 83 feet high by 925 feet long. A concrete-lined spillway channel located at the north end of the dam will have a capacity of 8,000 second-feet with a freeboard of 9 feet on the dam. During the fiscal year 1914 camp and construction buildings were completed and the construction plant assembled. On Upper Sherburne Lake, a large gravel-screening plant was erected. The gravel from this plant is delivered at the dam by floating equipment. The site of the dam and spillway was cleared and grubbed; excavation of foundation trenches was started, and concrete work on the outlet conduit and spillway channel was commenced.

Board meetings.

Subject.	Place.	Date.	Personnel.
St. Mary Canal and reservoirs		Sept. 19, 1904	
Storage and diversion, St. Mary River.	Babb, Mont	July 24–27, 1905.	F. H. Newell, C. E. Grunsky, Geo. Y. Wisner, H. N. Savage, C. C. Babb.
St. Mary Canal	do	May 19–26, 1905.	C. E. Grunsky, H. N. Savage, C. C. Babb.
St. Mary Reservoir and Canal	do	June 22, 1911	D. C. Henny, H. N. Savage.
Do	Helena, Mont	May 22, 1912	A. P. Davis, A. J. Wiley, H. N. Savage.
St. Mary Canal specifications and drawings.	do	Nov. 2, 1912	H. N. Savage, C. P. Williams, Joseph Wright, E. F. Tabor.
Do	Great Falls, Mont.	Sept. 20, 1913	D. C. Henny, H. N. Savage, C. P. Williams, Joseph Wright.
Sherburne Lakes Reservoir and Dam.	do	Mar. 15, 1914	D. C. Henny, H. N. Savage.
Excavation and structures, St. Mary Canal.	do	May 27, 1914	A. J. Wiley, H. N. Savage, C. P. Williams.
Sherburne Lakes Reservoir and Dam.	do	May 29, 1914	D. C. Henny, A. J. Wiley, H. N. Savage.
Drops, lower end St. Mary Canal	Fletcher, Mont	July 26, 1914	A. J. Wiley, H. N. Savage, W. W. Schlecht.
Sherburne Lakes outlet works	Portland, Oreg	Apr. 28, 1915	A. J. Wiley, D. C. Henny, F. Teichman, Chas. H. Swigart, E. G. Hopson.

CONSTRUCTION DURING FISCAL YEAR.

MILK RIVER PROJECT, MONT.

Chinook division.—No work was done on the Chinook division, excepting that the topographic sheets were completed, the surveys having been made during the preceding year.

Malta division.—On August 15 a washout occurred around the south abutment of Dodson diversion and a channel 100 feet wide by 30 feet deep was eroded. The rock-filled timber crib forming this structure was dismantled and replaced by a concrete abutment containing a 4 by 8 foot sluiceway, and an embankment built across the washed-out channel. This work was done by Government forces and was practically completed during January, 1916.

On Dodson South Canal contract No. 563 with the Security Bridge Co. for structures on canal and laterals of the second unit was completed on August 7, 1915, and contract No. 603 with James O'Connor for earthwork, relocation at Dodson Bridge, was completed on July 7, 1915.

On Bowdoin Canal bids for the excavation of the main canal, first unit, were opened on September 20, 1915, and contracts were awarded as follows:

No. 659 to James O'Connor for earthwork, and No. 658 to Jurgens, Booth & Co. for structures under Specifications No. 315. These contracts are practically completed. The completion of the first unit of Bowdoin Canal is covered by Specifications No. 327 and No. 340. On Specifications No. 327 the excavation has been awarded to L. W. Dotson, contract No. 692, and the structures to the Security Bridge Co., contract No. 694. Bids were opened June 22 for work on Specifications No. 340, but as yet contract has not been awarded.

At Nelson Reservoir the first development for the storage of 27,000 acre-feet, the outlet works, and the drop to Milk River were completed by the Security Bridge Co. on September 2, 1915. Work on the Nelson Reservoir South Canal was begun on July 8, 1915, and during the year the entire main canal was completed, with the exception of a small amount of excavation at the lower end and some of the structures. This work was done under the following contracts:

No. 641, with James O'Connor, for earthwork of the first 3 miles.

No. 651, with Winston Bros. Co., for earthwork, schedules 1 and 2 of Specifications No. 309.

No. 656, with Snelson Bros., for earthwork, schedule 3 of Specifications No. 309.

No. 660, with Jurgens, Booth & Co., for structures of the main canal, Specifications No. 314.

Glasgow division.—At Vandalia diversion the placing of the bridge seats, thrust bars, and anchorages, and the changes required in the bridge piers for the movable crest were completed by Government forces. Contracts Nos. 662 and 664 were awarded to the Lakeside Bridge & Steel Co. for bridges and operating mechanisms for the movable crest. Shopwork on these contracts is under way, but no work of erection has been begun. On the Vandalia South Canal the W. J. Hoy Co. contract No. 553, for work at Vandalia Point, was completed during July. The completion of this work was delayed by sliding ground, which required drainage.

ST. MARY STORAGE UNIT.

St. Mary Canal.—The construction on the canal was accomplished by contract, except the work included in the Midwest Engineering Co.'s suspended contract and the stretch of canal between stations 57 and 80, which was handled with Government forces. The earthwork on the canal, the concrete structures, one barrel of the St. Mary River crossing and Halls Coulee crossing pressure pipes, and one barrel of the Spider Lake Coulee flume were completed. The canal and concrete structures have a capacity of 850 second-feet. The pressure pipes and flume have a capacity of 425 second-feet. The second barrel of the pressure pipes and flume will be installed when additional water is required.

Sherburne Lakes Dam.—At Sherburne Lakes Dam all construction work was accomplished by Government forces. The completion of the dam was advanced during the year from 21 per cent to 49 per cent completed. That portion of the dam located south of Swiftcurrent Creek was practically completed. The construction of the outlet works, including the gate tower and gates, was nearly completed. The upper portion of the spillway channel was excavated. The total amount of excavation accomplished was 58,515 cubic yards; 2,457 cubic yards of concrete, 661 cubic yards of paving, and 10,032 cubic yards of screened gravel were placed.

SEEPAGE AND DRAINAGE.

There are a few areas on the project which will require drainage at some future time, but as yet no subsurface drains have been built. Waste-water ditches have been constructed to tap each farm, thereby affording each water user an outlet not only for waste water but also for the drainage of his holding. Sixty-five miles of waste-water ditches have been built.

ECONOMIES OF GOVERNMENT WORK.

ST. MARY STORAGE UNIT.

Logging poles and saw logs.—Bids were opened at Great Falls, Mont., on March 19, 1915. The lowest bid received for poles for fuel was for 1,500 cords at $3.25 and 2,000 cords at $2.75 per cord. Government forces logged the poles and cut them, by a portable saw outfit, into short lengths at a unit cost of $2.66 per cord. The lowest regular bid received for saw logs was for 200,000 feet board measure, at $8 per M. Government forces furnished the logs delivered on the rollway at the sawmill at a unit cost of $7.53 per M.

Sawing and surfacing lumber.—Bids were opened at Great Falls, Mont., on March 19, 1915. The lowest bid received for sawing and piling lumber was 300,000 feet board measure, at $8.75 per M feet. Government forces performed the work at a unit cost of $5.40 for

394,123 feet board measure. The lowest bid received for surfacing and piling lumber was 200,000 feet board measure, at $3 per M feet. Government forces performed the work, 198,438 feet board measure, at $4.14 per M feet. The saving on sawing the lumber was $1,420.31. The loss on surfacing the lumber was $226.22, leaving a net saving due to work of Government forces of $1,194.09.

Sherburne Lakes Dam.—As no bids were requested for the construction of this work, money comparisons can not be given, but it is certain that the changes made in the gate tower and spillway designs as the work was in progress would have proven extremely troublesome and expensive if the work had been under contract.

Construction of St. Mary Canal between Stations 57 and 80.—Bids were opened at Browning, Mont., August 9, 1915, for the construction of 2,300 feet of the St. Mary Canal. This work involved about 27,000 cubic yards of class 1 excavation. The lowest bid received was 57½ cents per cubic yard. The bids were rejected and the work was done with hired teams at a unit cost of 29 cents per cubic yard.

OPERATION AND MAINTENANCE.

During 1915 the Dodson North and South Canals were operated under water-rental contracts. Due to the washout at Dodson division no water was available for the North Canal after August 15, but water from Peoples Creek and stored water in Point of Rocks Reservoir was available for lands under the South Canal and furnished a supply sufficient to meet the demands for irrigation. The first water was turned into Vandalia South Canal on August 26, 1915, and allowed to run until October 16, during which time the main canal and laterals of the system were primed.

The growing season of 1915 was exceptionally favorable for farming operations, due to which the requirements for irrigation water service were less than anticipated.

During 1916 the Dodson North and South and the Vandalia South Canals were operated, and water was delivered under water-rental contracts. Until June 30 the entire supply, which, prior to the completion of the St. Mary storage unit, is derived from Milk River, was sufficient to meet all demands. Seventy-nine applications for water were received, covering an area of 4,460 acres.

During June, 1916, water was turned into the St. Mary Canal for priming and puddling preparatory to placing the canal in operation.

Historical review, Milk River project.

Item.	1911	1912	1913	1914	1915	1916[1]
Acreage for which service was prepared to supply water	7,800	7,800	12,800	13,440	40,000	45,000
Acreage irrigated	2,074	353	2,545	2,201	4,192	6,000
Number of farms irrigated	29	9	41	36	48	80
Miles of canal operated	30	30	59	53	86	120
Water diverted (acre-feet)	11,160	2,885	4,863	4,229	13,041	25,000
Water delivered to land (acre-feet)	2,853	293	2,349	1,760	2,884	4,000
Per acre of land irrigated (acre-feet)	1.38	0.82	0.92	0.80	0.69	0.67

[1] Estimated.

SETTLEMENT.

As no public notice announcing the opening of the project has been issued, no material progress has been made in settlement, although several transfers have been made of deeded lands. There are several large holdings of land, but little has been done toward subdividing and selling the excess holdings.

Settlement data of irrigated district, Milk River project.

Item.	1913	1914	1915	1916
Total number of farms on project	62	60	101	190
Population	126	130	210	400
Number of irrigated farms	41	37	48	80
Operated by owners or managers	32	25	29	60
Operated by tenants	9	12	19	20
Population	90	120	140	240
Number of towns	3	3	3	5
Population	900	1,105	1,460	4,200
Total population in towns and on farms	1,026	1,235	1,670	4,600
Number of public schools	4	5	6	14
Number of churches	2	6	6	14
Number of banks	2	3	3	7
Total capital stock	$75,000	$95,000	$95,000	$252,000
Total amount of deposits	$450,000	$530,000	$600,000	$1,959,000
Total number of depositors	1,400	1,700	1,800	6,615

PRINCIPAL CROPS.

Grain occupied 39 per cent and forage crops 61 per cent of the land cropped under irrigation in 1915. The crop results from these lands follow:

Crop report of irrigated lands on Milk River project, Montana, year of 1915.

Irrigated crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	665	Tons	1,470	2.2	$7.00	$10,290	$15.48
Barley	28	Bushels	609	22.0	.28	170	6.08
Corn, Indian	29	...do	1,010	35.0	.50	505	17.41
Flax	9	...do	198	22.0	1.45	287	31.90
Garden	10					1,150	115.00
Hay (other than alfalfa)	1,439	Tons	1,228	.9	8.00	9,824	6.82
Oats	558	Bushels	20,819	37.0	.35	7,297	13.08
Pasture	241					1,751	7.27
Potatoes	13	Bushels	2,045	157.0	.60	1,227	94.38
Wheat	895	...do	24,036	27.0	.78	18,748	20.95
Total acreage cropped under irrigation	3,887	Total and average				51,249	13.18
Irrigated, not cropped	305						
Total irrigated acreage	4,192						

Areas.	Acres.	Farms.	Per cent of project.
Total irrigable area farms reported	18,230	101	7.3
Total irrigated area farms reported: Under rental contracts	4,192	48	1.7
Total cropped area farms reported; irrigated and dry farmed	7,904	71	3.1

Crop report of lands dry farmed on Milk River project, Montana, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	142	Tons	84	0.6	$7.00	$588	$4.14
Barley	193	Bushels	3,746	19.0	.28	1,049	5.43
Corn, Indian	112	...do	2,805	25.0	.50	1,403	12.52
Flax	52	...do	654	13.0	1.45	948	18.24
Garden	6					825	137.50
Hay (other than alfalfa)	1,173	Tons	828	.7	8.00	6,624	5.65
Oats	769	Bushels	23,427	30.0	.35	8,199	10.66
Pasture	31					155	5.00
Potatoes	27	Bushels	2,668	99.0	.60	1,601	59.29
Wheat	1,512	...do	24,087	16.0	.78	18,788	12.43
Total acreage cropped by dry farming	4,017	Total and average				40,180	10.00

Areas.	Acres.	Farms.	Per cent of project.
Total irrigable area farms reported	18,230	101	7.3
Total irrigated area farms reported: Under rental contracts	4,192	48	1.7
Total cropped area farms reported, irrigated and dry farmed	7,904	71	3.1

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 710.]

Feature costs of Milk River project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examinations and surveys		$101,052.81
Storage system (Nelson Reservoir)		45,744.58
Canal system:		
Ashfield Canal	$79.13	
Bowdoin Canal	51,295.39	
Chinook Canal	5,063.25	
Dodson diversion	259,529.49	
Dodson North Canal	207,466.50	
Dodson South Canal	690,317.12	
Nelson Reservoir South Canal	97,030.28	
Vandalia South Canal	801,048.80	
		2,111,829.96
Lateral system:		
Ashfield Canal	25.33	
Bowdoin Canal	11,808.63	
Dodson North Canal	110,745.42	
Dodson South Canal	131,846.28	
Nelson Reservoir South Canal	12,627.62	
Vandalia South Canal	111,124.55	
		378,177.83
Flood protection (Vandalia South Canal)		1,187.77
Farm units:		
Dodson North Canal	6,001.05	
Dodson South Canal	7,777.19	
Vandalia South Canal	1,748.75	
		15,526.99
Permanent improvements and land:		
Wagner camp	4,232.84	
Malta headquarters	13,874.71	
Nelson Reservoir South, operation and maintenance	834.75	
Paisley camp	10.95	
		18,953.25
Telephone system		457.16
Operation and maintenance during construction		51,015.21
Plant accounts		17,754.38
Gross cost of construction to June 30, 1916		2,741,699.94
Less revenues earned during construction period:		
Rental of buildings	1,743.13	
Rental of grazing and farming lands	1,769.00	
Rental of irrigation water	11,834.17	
Contractors' freight refunds	13,582.71	

Feature costs of Milk River project to June 30, 1916—Continued.

Features.	Subfeature.	Principal feature.
Less revenues earned during construction period—Continued.		
Forfeitures by defaulting bidders and contractors	$1,865.26	
Sale of town site lots	[1] 239.78	
Other revenues, unclassified	168.15	
Profit on messhouse operations	3,901.52	
Profit on mercantile store operations	3,597.17	
Profit on hospital operations	470.01	$61,445.72
Net cost of construction of project to June 30, 1916		2,680,254.22

[1] Deduct.

Feature costs of St. Mary storage unit to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys		$47,113.46
Storage works:		
Preliminary and general work	$67,877.72	
Sherburne Lakes Dam	288,277.66	356,155.38
Canal system:		
Preliminary and general work	132,249.86	
Temporary headworks, Kennedy Creek	1,107.74	
Diversion dam and headworks	52,570.38	
Diversion dam, Swiftcurrent Creek	83,288.23	
Main canal	702,420.63	
Spider Lake Coulee Flume	36,177.87	
Bridges, highway across main canal	11,488.05	
Control check gate, station 615+20	12,516.80	
Control check gate, station 91	7,864.40	
Drops	82,821.45	
Siphon, St. Mary River Crossing	121,990.36	
Siphon, Halls Coulee Crossing	34,355.30	
Kennedy Creek control check and sluice gates	13,238.42	
Kennedy Creek Crossing	30,792.51	
Wasteway, sluice gate, station 884	10,703.55	
Culvert, Powell Creek Crossing	7,389.13	
Culverts east of Cow Creek	15,853.74	
Culverts, Cow Creek	4,972.22	
Coal mine	3,374.02	
Administrative general expense	8,911.85	1,374,086.51
Lateral system:		
Preliminary and general work	102.17	
Uphams ditch	1,066.78	
Administrative general expense	.86	1,169.81
Flood protection:		
Preliminary and general work	607.20	
Kennedy Creek Dike	23,082.96	
Earth dikes, stations 372 and 380	967.38	
Administrative general expense	3.08	24,660.62
Permanent improvements and land:		
Buildings	5,321.15	
Roads	111,575.30	
Bridges	37,520.04	
Water system	5,322.76	
Administrative general expense	559.51	160,298.76
Telephone system		11,830.75
Operation and maintenance during construction		15,960.32
Plant accounts		96,573.94
Gross cost of construction of project to June 30, 1916		2,087,849.55
Less revenues earned during construction period:		
Rental of buildings	14,774.93	
Rental of telephones and tolls	684.95	
Contractors' freight refunds	6,499.10	
Forfeitures by defaulting bidders and contractors	1,893.22	
Other revenues, unclassified	8.50	
Loss on messhouse operations	[1] 3,802.38	
Profit on mercantile store operations	4,694.34	
Profit on hospital operations	2,270.14	27,022.80
Net cost of construction of project to June 30, 1916		2,060,826.75

[1] Deduct.

Estimated cost of contemplated work, Milk River project, during fiscal year 1917.

Features.	Sub-feature.	Principal feature.
Examination and surveys:		
Hydrographic surveys	$3,500	
Investigations	1,000	
		$4,500
Storage system:		
Nelson Reservoir	2,100	
Beaver Creek Reservoir	700	
		2,800
Canal system:		
Miscellaneous, installing gates, etc	2,750	
Bowdoin Canal	11,250	
Nelson Reservoir South Canal	20,300	
Vandalia South Canal	45,000	
		79,300
Lateral system:		
General preliminary work	3,200	
Bowdoin Canal	54,000	
Nelson Reservoir south laterals	192,800	
		250,000
Drainage system: General and preliminary work		500
Flood protection (general)		500
Farm units (general)		3,200
Permanent improvements and land (general)		1,200
Telephone system (Malta to Dodson Dam)		4,500
Operation and maintenance (water rental)		15,000
Messes		900
Mercantile stores		150
Hospitals		750
Total		363,300

Estimated cost of contemplated work, St. Mary storage unit, Milk River project, during fiscal year 1917.

Features.	Sub-feature.	Principal feature.
Examination and surveys:		
Topographic surveys	$1,400	
Stream gaging	1,400	
		$2,800
Storage works:		
Sherburne Lakes Reservoir Dam	132,800	
Sherburne Lakes Reservoir spillway	120,000	
		252,800
Permanent improvements and land:		
Buildings	600	
Roads	10,000	
Purchase of rights of way	5,400	
		16,000
Telephone system (construction of 20 miles of metallic circuit telephone line)		3,700
Operation and maintenance during construction (water-rental basis):		
Operation	4,700	
Maintenance	16,300	
		21,000
Messes		13,000
Mercantile stores		1,000
Hospitals		2,000
Total		312,300

MONTANA, SUN RIVER PROJECT.

CHARLES P. WILLIAMS, senior engineer, Fort Shaw, Mont.

LOCATION.

Counties: Teton, Lewis and Clark, Choteau, Cascade.

Townships: 20 to 25 N., Rs. 6 E. to 8 W., Montana meridian.

Railroad: Great Northern.

Railroad stations and estimated population January 1, 1916: Vaughn;[1] Largent;[1] Sun River, 36; Fort Shaw, 51; Simms, 86; Riebling;[1] Gilman, 240; Power, 52; Cordova;[1] Sloan;[1] and Bole, 120.

WATER SUPPLY.

Source of water supply: Sun River and tributaries, Deep Creek, Bowl Creek, and Basin Creek.

Area of drainage basins: Sun River, 1,070 square miles; Deep Creek, 260 square miles; Bowl Creek, 9 square miles; Basin Creek, 15 square miles.

Annual run-off in acre-feet: North Fork of Sun River, near Augusta, 1905–1915, maximum, 808,000; minimum, 327,000; mean, 600,000. Willow Creek, near Augusta, 1906–1915, maximum, 35,300; minimum. 8,000; mean, 19,300. Sun River, at Sun River, 1906–1912, and at Fort Shaw, 1913–1915, maximum, 1,080,000; minimum, 360,000; mean, 729,000. South Fork of Sun River, near Augusta, 1905–1915, maximum, 139,000; minimum, 28,000; mean, 68,200.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916: 16,322 acres.

Area under water-right applications, season of 1916: 11,129 acres.

Area under rental contracts, season of 1916: 40 acres.

Area having vested water rights: 218.3 acres.

Length of irrigating season: From May 16, to October 10, 163 days.

Average elevation of irrigable area: 3,700 feet above sea level.

Rainfall on irrigable area: For 28 years average, 11 inches; 1915, 16.2 inches.

Range of temperature on irrigable area: —40° to 100° F.

Character of soil of irrigable area: Sandy loam, clay, adobe, and alluvium.

Principal products: Hay, grain, and vegetables.

Principal markets: Great Falls, Seattle, St. Paul, Minneapolis, and Chicago.

LANDS OPENED FOR IRRIGATION.

Dates of public notices: March 26, 1908; November 19, 1910; March 28, 1911; March 2 and July 13, 1912; June 23, 1913; September 24, 1914; March 20 and March 26, 1915; and January 15, 1916.

Location of lands opened: Tps. 20 and 21 N., Rs. 1 to 3 W., Montana meridian.

Present status of irrigable lands opened: 10,496.09 acres entered subject to the reclamation act; 2,249.82 acres open to entry; 268.34 acres State land; 1,715.78 acres in private ownership which have not applied for water, 633.11 acres in private ownership which have applied for water; 218.3 acres in private ownership under vested water-right contracts; 320 acres in town sites; 420.3 acres in reservations other than town sites.

Limit of area of farm units: 160 acres.

Duty of water: 2 acre-feet per acre per annum at the farm.

Building charge per acre of irrigable land: $30 and $36.

Annual operation and maintenance charge: For the irrigation year 1915, 90 cents per acre of irrigable land entitling the water user to one acre-foot of water per acre, with an additional charge of 75 cents for each additional acre-foot of water used. For the season of 1916, $1.10 per acre of irrigable land entitling the water user to 1.5 acre-feet of water per acre with an additional charge of 50 cents for each additional acre-foot of water used.

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[1] Population less than 25.

CHRONOLOGICAL SUMMARY.

Reconnoissance made and preliminary surveys begun in 1905.
Construction recommended by board of engineers February 13, 1906.
Construction authorized by Secretary February 26, 1906.
Fort Shaw Main Canal completed July, 1908.
First irrigation by Reclamation Service season of 1909.
Fort Shaw unit completed December, 1909.
Willow Creek Dam completed, present development, November 7, 1911.
Sun River Diversion Dam completed March, 1915.
Entire project 39.1 per cent completed June 30, 1916. (Based on the ratio of expenditures to date to estimated cost of complete works for 174,000 acres.)

IRRIGATION PLAN.

The irrigation plan of the Sun River project, so far approved, provides for the storage of water in Sun River storage reservoir on the North Fork of Sun River, in the Willow Creek Reservoir on Willow Creek, and in Pishkun Reservoir north of Sun River; the diversion of water from the North Fork of Sun River through a supply canal for the Pishkun Reservoir; the diversion of water from Sun River, supplemented by stored waters released from Sun River storage and Willow Creek Reservoir, into a canal system watering lands mainly in the abandoned Fort Shaw Military Reservation; and the diversion of water from Pishkun Reservoir into the Sun River Slope Canal, supplying water for lands on the north side of Sun River.

Possible future development may include the diversion of water from Bowl and Basin Creeks, tributaries of Flathead River, across the Continental Divide to Sun River drainage; the diversion of water from the North Fork of Sun River into a supply canal for Willow Creek Reservoir; the diversion of flood waters from Deep Creek into Pishkun Reservoir; the construction of a reservoir on Muddy Creek and of a canal system leading therefrom for the irrigation of lands lying on the north side of Sun River in the vicinity of Vaughn and Manchester; the storage of water in Benton Lake Reservoir for the irrigation of lands lying north of Great Falls; and the diversion of water from the Sun River for the irrigation of lands lying west of Great Falls.

The United States claims all waste, seepage, spring, and percolating water arising within the project and proposes to use such water in connection therewith.

The Fort Shaw unit, the Willow Creek Reservoir (first development, 16,700 acre-feet), the Pishkun Supply Canal, except Sun River crossing and a short reach of canal lining (first development of 1,000 second-feet), and the Sun River Slope Canal (first development of 500 second-feet) have been completed. The Sun River crossing is under construction and will be completed this working season. The three main canals of the Greenfields division, namely, the Greenfields, South Greenfields, and Mill Coulee Canals, covering about 75,000 acres, have been excavated. The lateral system for about 25,000 acres under the Greenfields Canal is being constructed under contract.

SUMMARY OF GENERAL DATA FOR SUN RIVER PROJECT TO JUNE 30, 1916.

Areas:	
Irrigable acreage when project is complete	174, 022
Public land entered, June 30, 1916	46, 434
Public land open to entry June 30, 1916	2, 312
Public land withdrawn, June 30, 1916	36, 078
State land, June 30, 1916	12, 546
Private land, June 30, 1916	76, 652
Acreage service could have supplied season of 1915	16, 346
Estimated addition in fiscal year 1917	24, 675
Estimated acreage service can supply July 1, 1917	41, 021

Areas—Continued.			
Acreage actually irrigated, season of 1915			4,261
Acreage cropped under irrigation, season of 1915			[1] 6,665
Acreage dry farmed, season of 1915			839
Crops:			
Value of irrigated crops, season of 1915			$115,129
Value of irrigated crops, per acre cropped			$17.29
Value of dry-farmed crops, season of 1915			$12,258
Value of dry-farmed crops, per acre cropped			$14.60
Finances:			
Estimated cost of completed project			$8,250,000
Total construction cost to June 30, 1916			$3,094,611.45
Per cent complete, June 30, 1916			39.1
Appropriation for fiscal year 1917, total			$205,000
Allotment for construction, fiscal year 1917			$206,000
Estimated per cent complete June 30, 1917			40
Announced construction charges per acre			$30–$36
Appropriation, fiscal year 1916			$1,000,000.00
Expenditures during fiscal year chargeable to 1916 appropriation—			
Disbursements	$576,241.58		
Transfers	27,894.07		
		$604,135.65	
Registered liabilities chargeable to 1916 appropriation		59,133.07	
Contract obligations wholly covered by 1916 appropriation		78,444.12	
Estimated enginering expenses on contract work wholly covered by 1916 appropriation		10,600.00	
			$752,312.84
Unencumbered balance, July 1, 1916			$347,687.16
Repayments:			
Construction charges—			
Accrued to June 30, 1916			$100,406.05
Collected to June 30, 1916			$97,592.80
Uncollected, June 30, 1916			$2,813.25
Operation and maintenance charges (public notice)—			
Accrued to June 30, 1916			$43,721.03
Collected to June 30, 1916			$41,619.26
Uncollected, June 30, 1916			$2,101.77
Water-rental charges accrued to June 30, 1916			$497.79
Drainage: Estimated acreage damaged by seepage to June 30, 1916			2,300

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

WILLOW CREEK DAM.

Proposals for the construction of Willow Creek Dam and outlet works were requested for opening on March 15, 1907. No proposals were received, and the construction of this feature by Government forces was authorized on April 29, 1907. The plans for Willow Creek Dam provide for an earth-fill structure, with a crest length of 1,045 feet and a maximum height of about 110 feet. The downstream face has a slope of 2 to 1 and the upstream face has a slope of 3 to 1 and is riprapped with a 2-foot thickness of loose gravel and bowlders. The controlling works consist of a tunnel, gate chamber, gate shaft, and gate house.

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[1] Some of the irrigable lands cropped were not irrigated on account of the unusually large rainfall.

During 1907 the tunnel was driven, excavation for the gate shaft was made, and the concrete lining of the tunnel was placed. The contract for the circular sluice gate, wall pipe, shaft for gate, shaft guides, and gate stand for the outlet tunnel was awarded in April, 1907, and the work was completed in March, 1910.

In the latter half of 1910 a steam shovel was purchased, locomotives and dump cars were transferred from the Umatilla project, and the construction of the embankment was begun by train haul. The concrete stilling basin at the outlet of the tunnel was completed in September, 1910. Construction of the embankment was continued until January 1, 1911, when work was suspended on account of frost. At that time the upstream portion of the dam had been built to a height of about 20 feet above the tunnel intake.

During the winter of 1910–11 the plant was overhauled and riprap was placed on the upstream face of the dam. Construction of the embankment was resumed in April, 1911, and continued with minor interruptions until the completion of the dam. In May, 1911, the method of transporting material in cars was changed to that of hauling in dump wagons, and a new borrow pit was opened south of the dam, which reduced the length of haul to about 700 feet. During the period when material was being hauled in dump cars the faces of the dam were kept higher than the middle, a pool of water was kept on the top of the embankment and the material was dumped into this pool and spread by a stream from a hose. When the material was hauled in dump wagons it was dumped in rows, spread in layers, sprinkled with a hose, and rolled with a 10-ton traction engine and with a roller of railway car wheels. The layers were 4 to 6 inches thick after rolling. Rock in excess of 4 by 4 by 3 inches was removed from the embankment and was used as riprap. The dam was completed to the height required by first development, 70 feet maximum height above stream bed, in November, 1911, and stores 16,700 acre-feet, with water surface 10 feet below the crest.

FORT SHAW CANAL SYSTEM.

Proposals for the construction of the Fort Shaw Canal system were opened on April 3, 1907. The specifications provided for five divisions of the work, each containing separate schedules for excavation and for structures. Division 1 included about 6 miles of main canal from the headworks to the east end of Simms Creek siphon; division 2 included about 6 miles of canal from the east end of Simms Creek siphon to the end of the main canal; division 3 included about 21 miles of laterals and sublaterals; division 4 included about 39 miles of laterals, sublaterals, and waste-water ditches; and division 5 included about 24 miles of laterals and sublaterals. Separate contracts were entered into for the excavation on each division. No proposals for the building of structures were received, and on April 29, 1907, authority was granted for executing this work by Government forces. Practically all the work of excavation and construction on the canal system was completed by June 30, 1908.

NORTH SIDE IRRIGATION SYSTEM.

The plan for the irrigation of lands on the north side of Sun River provides for the diversion of water on at the lower end of Sun River Canyon into the Pishkun Canal, through which water will be conveyed to Pishkun Reservoir. Water will be delivered from the reservoir into the Sun River Slope Canal, through which it will be conveyed to the irrigable lands. The Spring Valley division lies directly under the lower reach of the Sun River Slope Canal. The Sun River Slope Canal will deliver water at the upper or westerly end of the Greenfields division, whence it will be carried to the various parts of this division through the Greenfields, South Greenfields, and Mill Coulee main laterals. At least a portion of the Greenfields Lake unit also will be supplied with water by the Sun River Slope Canal.

Pishkun Canal is 12½ miles in length and was designed to have an ultimate capacity of 2,500 second-feet. It has been constructed to a capacity of 1,000, but in such manner as to permit enlargement to the designed ultimate capacity. Water will be diverted into the Pishkun Canal by means of the Sun River Diversion Dam, an arched concrete dam 97 feet in height above low water. The diverted water will be conveyed first through tunnel No. 1, 700 feet in length, and situated on the south side of Sun River, thence through a concrete conduit, 860 feet in length, rectangular in section and constructed in cut and cover, and thence in open canal to the Sun River Crossing where the water will be carried across the Sun River in a wood-stave pipe, supported where it crosses the river channel by a steel bridge consisting of two spans, each 110 feet in length. This bridge will serve also as a highway crossing. The siphon will have concrete intake and outlet structures. The principal structures on the Pishkun Canal below Sun River crossing are a combined spillway, wasteway, and culvert at Green Timber Gulch, Tunnels Nos. 2 and 3, the drop into Arnold Coulee and the drop into Pishkun Reservoir at the end of the canal.

The Sun River Slope Canal is 34 miles in length and was designed to have an ultimate capacity of 1,000 second-feet. The canal has been excavated to a capacity of 500 second-feet, but all structures have been built for the designed ultimate capacity with a view to the enlargement of the excavated canal. The principal structures on the canal are the controlling works at Pishkun Reservoir and the first and second drops into Big Coulee.

USE OF ELECTRIC ENERGY.

Under contract dated February 19, 1913, electric energy is purchased by the United States from the Great Falls Power Co. for use in construction. The contract with the power company provides for a minimum total payment by the United States of $60,000 during six years after the contract became effective. The total use under the contract to June 30, 1916, amounted to about $20,000. The power company has constructed a transmission line, about 75 miles in length, from its Rainbow Falls plant to the site of the Sun River Diversion Dam and delivers energy to the United States at three substations along this line. The United States has constructed a transmission line connecting with the various substations and extending along the canal line and has sold power to contractors at from 1 cent to 1.2 cents per kilowatt-hour.

SUN RIVER DIVERSION DAM.

From April to December, 1911, diamond-drill borings were made on the North Fork of Sun River just above the mouth of Sun River Canyon to determine the suitability of the site for the construction of an arched concrete diversion dam for the diversion of water into the Pishkun Supply Canal. Late in the fall of 1912 a temporary camp was established on the flat below the dam site. A contract was entered into with John L. B. Mayer of Augusta to cut and manufacture on Beaver Creek, about 9 miles above the dam site, lumber required for a camp, temporary flume, forms, and miscellaneous uses. Delivery of lumber commenced in December, 1912. The construction of a camp to accommodate construction labor for the dam was started immediately. In May, 1913, construction was begun of a temporary diversion flume about 1,500 feet long to carry the river from the lower falls above the dam site through the canyon to the open channel below. This was completed in September, 1913, and work was begun immediately thereafter on stripping the foundation. Water seeping through the temporary diversion dam and back seepage from the river below was pumped into the flume by an electrically-driven centrifugal pump. Gravel and sand for concrete were obtained from a pit on the south side of the river a mile above the dam. The excavation for the foundation was completed in December, 1913, and about 1,000 cubic yards of concrete were placed in the base bringing the dam up to a point about 10 feet above the sill of the lower temporary outlet gate. Water then was turned through this outlet, the temporary flume was dismantled, and operations were suspended until July, 1914.

In July, 1914, after high water had gone down the top of the concrete in the base of the dam was cleaned and chipped, a new concrete plant erected at a point high enough to complete the dam, and a new derrick erected adjacent to the south pier. Concreting was resumed in August, 1914. The dam was constructed to a height of 10 feet above the gate sill of the upper temporary outlet, after which the lower temporary gate was closed and the lower temporary outlet conduit filled with concrete. The placing of concrete in the dam was completed in November, 1914. Forms were removed and the construction plant dismantled during the winter. All work on the dam was completed in March, 1915. The upper outlet gate was closed and water turned over the crest of the dam in April, 1915.

TUNNEL NO. 1.

Tunnel No. 1 (693 feet long) was constructed by Government forces. Work was begun from the lower portal in October, 1913. Excavation was in sound limestone with a dip of about 45° and a strike about normal to the line of the tunnel. The tunnel was driven with a bottom heading about 8 feet wide and 8 feet high, taking down the top and remaining side about 25 to 50 feet behind the heading. One drilling shift and one mucking shift were continued through the winter and the tunnel was holed through and trimmed in April, 1914. This tunnel when completed will have a concrete lining and will be of horseshoe section, having a net diameter, except for a small reach at its upstream end, of 11 feet. Lining will not be placed until it is necessary to increase the carrying capacity of the tunnel. The construction of the concrete headworks at the portal of tunnel No. 1 and lining with concrete of 40 linear feet at the lower end of the tunnel were done during the winter of 1914–15 and completed in February, 1915.

PISHKUN SUPPLY CANAL, SUN RIVER SLOPE CANAL, AND TUNNELS 2 AND 3.

On December 8, 1914, proposals were received under specifications 283 for the construction of the Pishkun Supply Canal from the lower end of tunnel No. 1 at station 8+60 to station 38+53 at Sun River crossing. The Bates & Rogers Construction Co., of Spokane, Wash., were low bidders and the work was awarded to them for an estimated amount of about $40,000; contract No. 610 for the work was dated January 19, 1915. This work consisted of about 800 linear feet of rectangular concrete conduit, about 2,000 feet of open-cut canal in heavy gravel, and a concrete lip spillway and discharge channel. Work was begun in March, 1915, on the excavation for the conduit. The major portion of the excavation was performed with a drag-line excavator built on the job and operated with compressed air from the United States Reclamation Service compressor plant. The work was delayed considerably by heavy rains and scarcity of labor, but was completed without serious difficulty in August, 1915. Contract payments under this contract amounted to $31,390.05.

On April 30, 1913, proposals were received under specifications 232 for the excavation of the Pishkun Supply Canal from Sun River crossing to Pishkun Reservoir, the driving and lining of tunnels on that canal, and the excavation of the Sun River Slope Canal. On September 17, 1913, contract covering this work was executed with MacArthur Bros Co., of New York, for an estimated total amount of about $860,000. Construction was begun on schedule 4 early in October, 1913, and continued without material interruption until the completion of the schedule in September, 1914. This schedule, comprising the Greenfields division of the Sun River Slope Canal, consisted of 5 miles of sidehill work with considerable sandstone, shale, and heavy gravel, and 4 miles of easy construction on Greenfields bench. All excavation in this schedule was done with teams.

Work was begun in November, 1913, on tunnel No. 2, 1,022 feet long, and tunnel No. 3, 2,277 feet long. Tunnel No. 2, having a horseshoe section 12 feet in diameter, was largely in hard black shale, which was stable and required no timbering. Drilling was done entirely with hand steel. Tunnel No. 3, having a horseshoe section 10 feet 8 inches in diameter, was in a close-grained sandstone, with seams twisting around the tunnel bore. Several mud seams were encountered requiring about 157 feet of timbered section near the west portal. Drilling was done partly by hand steel and partly by electrically driven augers, the latter method working very successfully. Excavation of both tunnels was completed in August, 1914, and work was started immediately on trimming preparatory to lining. Lining was started in November, 1914, on tunnel No. 3 and continued with minor interruptions until the tunnels were completed in October, 1915.

The remainder of the canal excavation, except about 3 miles which was performed with teams, was done with two electric drag-line excavators receiving power from the Government transmission line along the canals. Work with these machines was begun in February, 1914, and continued, with one shutdown of about three months in the winter of 1914–15, until the completion of the work early in April, 1916. The use of electric power was most successful and resulted in a low unit cost to the contractor. Contract payments under this contract amounted to $954,948.35.

Proposals were received December 18, 1913, for the construction of structures, except tunnels, on the Pishkun Supply Canal below Sun River crossing and on the Sun River Slope Canal. Contract dated January 24, 1914, was executed with Hayden Bros., of Portland, Oreg., for an estimated total of $245,000. Work was begun under this contract in March, 1914. The first season's progress was slow, but early in the season of 1915 the contractor increased his force and equipment, and the contract was completed without serious difficulty in December, 1915. The principal structures on the work were a combined siphon spillway, sluiceway, and culvert at Green Timber Gulch; four large pipe drops, of 850 to 1,250 second-feet capacity, and 36 to 155 feet in height; and nearly 2 miles of concrete canal lining. All construction machinery was electrically driven by power obtained from the transmission line along the canals. Contract payments under this contract amounted to $312,524.04.

SUN RIVER CROSSING.

Work was started on the excavation for Sun River crossing by Government forces in October, 1914, but lack of funds caused the suspension of the work in January, 1915. Funds became available in the fiscal year 1916 and work was resumed in October, 1915, on the excavation of the trench for the pipe and the foundation for the bridge piers. Concreting of bridge piers was begun in December, 1915, and completed in May, 1916. Proposals were received January 24, 1916, for the furnishing and erection of the steel bridge, and contract was executed February 21, 1916, with the Des Moines Bridge & Iron Co., at a price of $7,000 for furnishing the bridge and $2,000 for the erection. The bridge has been fabricated and delivered at Gilman, Mont., but high water has prevented its erection. Proposals were received March 20, 1916, for furnishing and erecting the 96-inch wood-stave pipe for this structure. One proposal was received from the Pacific Tank & Pipe Co., but was rejected, as it appeared sufficient time had not been allowed bidders to obtain quotations on materials for the pipe. Proposals for furnishing and erecting the pipe were received again May 5, 1916, and contract dated June 10, 1916, was executed with the Pacific Tank & Pipe Co. for a total amount of $7,817.50. The work of grading the approaches to the bridge, excavating the trench for the pipe, and constructing the concrete intake and outlet structures for the pipe is being done with Government forces.

GREENFIELDS DISTRIBUTION SYSTEM.

The Greenfields distribution system receives water from the Sun River Slope Canal and will cover an irrigable area of about 75,000 acres. Proposals were received December 22, 1914, for the excavation of the Greenfields, South Greenfields, and Mill Coulee laterals, which will deliver water to about 65,000 acres. The lowest bidders on the work were O'Connor & Helean, of Great Falls, Mont., and the work was awarded to them under contract dated February 2, 1915. Work was begun March 22, 1915, and completed November 6, 1915. Contract payments for this work amounted to $62,806.35.

Proposals were received July 1, 1915, for the construction of laterals and structures for delivering water to about 25,000 acres of entered lands in the first unit of the Greenfields division and lying under the Greenfields main lateral. Schedules 1 to 5, inclusive, covering the excavation of the laterals, were awarded to J. E. Hilton, of Billings, Mont., for an estimated amount of about $46,500 under contract dated September 18, 1915. On June 30, 1916, about 75 per cent of the work had been completed. Schedules 6 to 9, inclusive, covering the construction of structures, except highway bridges, were awarded to the West Coast Construction Co. and Hans Pederson, of Seattle Wash., for an estimated amount of about $66,000, under contract dated September 2, 1915. On June 30, 1916, only about 18 per cent of the work had been completed. Schedule 10, covering highway bridges, was awarded to Threet Bros. & Jolley, of Lovell, Wyo., for an estimated amount of about $75,000. under contract dated August 30, 1915. On June 30, 1916, about 98 per cent of the work under this contract had been completed.

ROAD CONSTRUCTION.

During May and June, 1911, a small Government force constructed a short reach of wagon road at the site of the Sun River Diversion Dam to facilitate the delivery at the site of diamond drill equipment. In March, 1912, this road was extended a short distance westward and the grades reduced.

In September, 1911, construction by Government forces was begun on a road from the site of Sun River Diversion Dam to the Warm Springs on the North Fork of the North Fork of Sun River and about 10 miles above the site of the diversion dam. About 6 miles of road were constructed suitable for the transportation of equipment, materials, and supplies for diamond drill work at the Limestone Reef dam site.

In December, 1912, a road about 4 miles in length was built from the North Fork road up Beaver Creek for use in hauling lumber for a sawmill on that creek to the Sun River Diversion Dam.

In April, 1913, construction was begun on a road from Gilman, the terminus of the Sun River branch of the Great Northern Railway, to the site of the Sun River Diversion Dam, a distance of about 21 miles. It was necessary to build only about 11 miles of roadway in order to secure a serviceable road with maximum grades of 6 per cent westward and 8 per cent eastward. A pile trestle wagon bridge about 180 feet long was built across the North Fork of Sun River about a mile below the site of the diversion dam. The cost of the 11 miles of road was about $7,600 and of the bridge about $2,500.

TELEPHONE LINES.

In October to December, 1911, a telephone line was constructed by Government forces from Willow Creek Reservoir to Sun River diversion dam site and thence to the Limestone Reef dam site. From Willow Creek Reservoir to Sun River diversion dam site, a distance of about 16 miles, the line was built in accordance with standard practice, 25-foot cedar poles being used. Above Sun River diversion dam site shorter poles were used, and where practicable the wires were hung on trees.

At the time of the construction of the Government electric transmission line, built in 1913 and 1914, a telephone circuit was hung on the transmission line poles, extending from the Sun River diversion dam site to the end of the transmission line at about mile 4 of the Greenfields division of the Sun River Slope Canal. In the fall of 1914 this telephone line was extended eastward along the southerly side of the Greenfields bench and to the project headquarters at Fort Shaw, a distance of about 18 miles. A branch line was built northward, 3½ miles, from this line to United States Reclamation Service camp 9 in section 21, township 22 north, range 2 west. In the late summer of 1915 this north branch line was extended about 4 miles to the United States Reclamation warehouse at Sloan, on the Choteau branch of the Great Northern Railway. These lines have two No. 12 galvanized wires on 25-foot cedar poles, placed about 175 feet apart, except for the upper 5 miles along the Greenfields division, where the poles are 30 feet in length.

CONSTRUCTION DURING FISCAL YEAR.

At the beginning of the fiscal year work was in progress on the Pishkun Supply Canal and the Sun River Slope Canal under contract 511 with MacArthur Bros. Co., contract 532 with Hayden Bros., and contract 610 with Bates & Rogers Construction Co. On the Greenfields distribution system work was in progress on contract 615 with O'Connor & Helean. No work by Government forces was in progress.

PISHKUN SUPPLY AND SUN RIVER SLOPE CANALS.

Work on contract 511 with MacArthur Bros. Co., covering the excavation of the Pishkun Supply Canal below Sun River crossing, the driving and lining with concrete of tunnels Nos. 2 and 3 on that canal, and the excavation of the Sun River Slope Canal was about 87 per cent completed on July 1, 1915. Buchanan & Co., subcontractors, continued the excavation of the upper end of the Pishkun Supply Canal with their class 20 electric drag-line excavator, and after six weeks' shutdown on account of extremely cold weather in December and January completed this portion of the work in March, 1916. Work on tunnels 2 and 3, under Olof Olson, subcontractor, was in progress, and consisted in placing concrete in tunnel floors and portals and the construction of paving and timber cribs at the portals. This work proceeded slowly, and was completed in October, 1915. Yale & Reagan, subcontractors, with their class 24 electric drag line, worked on the lower end of the Spring Valley division, Sun River Slope Canal, excavating the canal at the rate of about 2 miles per month, and completing their work in October, 1915. The last work to be completed on the contract was the excavation by Olof Olson of a heavy rock cut east of tunnel No. 3. This work was delayed by unfavorable climatic conditions and the necessity of trimming to neat lines for lining, and was not completed until April, 1916.

Work under contract No. 532 with Hayden Bros., covering the construction of structures on the Pishkun Supply Canal below Sun River crossing, except tunnels Nos. 2 and 3, and the construction of structures on the Sun River Slope Canal was about 65 per cent completed on July 1, 1915. Work was in progress on the structures throughout the lower end of the Pishkun Supply Canal and the entire length of the Spring Valley division, Sun River Slope Canal. All structures on the Pishkun Supply Canal were completed in November, 1915, except the drop into Pishkun reservoir. At this structure sound rock was encountered at about the elevation of the top of the proposed stilling basin. For this reason the construction of the basin was omitted, the pipe was turned on a long radius curve into a short horizontal section well bonded into the rock foundation, and heavy riprap was placed to protect the back fill of the pipe above the rock foundation. This structure was completed December 13, 1915.

Four crews worked on the Spring Valley division of the Sun River Slope Canal throughout the latter half of the season of 1915. Two crews built culverts, siphon spillways, and bridges; one crew constructed concrete canal lining in miles 7 and 8; and the fourth crew constructed the first and second drops into Big Coulee. Good progress was made by all crews, but the work on the lower end of the division was handicapped by difficulty in obtaining suitable sand for concrete. All work on the division was completed November 30, 1915.

The contractor was released from the completion of the concrete canal lining below tunnel No. 3 on the Pishkun Supply Canal, and the bridge at mile 12, Spring Valley division, on account of the fact that the excavation of this reach of canal had not been completed by MacArthur Bros. Co. On account of delays occasioned by unforeseen causes beyond the control of the contractors, the time limit of the contract was extended on schedule 1 to January 8, 1916, on schedule 2 to January 18, 1916, and on schedule 3 to December 1, 1915.

Work on contract 610 with Bates & Rogers Construction Co., covering the construction of the Pishkun Supply Canal above Sun River crossing, was about 57 per cent completed on July 1, 1915. The major portion of the earthwork was performed with a drag-line excavator built on the work and operated by a double-drum hoisting engine with swinging gear, using as power compressed air from the Reclamation Service power plant. The machine was supplemented by team and hand work. Concrete was distributed from a central plant by means of a tower and chutes and two-wheeled carts. Sand and gravel were obtained from the pit and screening plant used formerly by the Reclamation Service in the construction of Sun River Diversion Dam. On account of unavoidable delays which could not have been foreseen by the contractor and extra work required, an extension of time was granted to August 30, 1915, on which date the work was completed.

Work by Government forces on Sun River crossing was resumed in October, 1915. A small amount of excavation had been performed on the north side of the river the previous year. Excavation for the two shore bridge piers was performed without cofferdams, as there was only a small amount of inflow; the center bridge pier was cofferdammed with sacks. All pier foundations were carried well into sound rock. Concreting of piers was done in December, 1915, but revision of the tops of piers required by a change in plans for the bridge seats delayed the completion of the piers until May, 1916. During the winter months, although handicapped by extreme cold weather, work was prosecuted on the road approaches to the bridge and on the excavation for the wood-stave pipe and the intake and outlet structures. The construction of the concrete-canal lining above the intake structure was begun in May, 1916, and at the close of the fiscal year the intake and canal lining were nearly completed, a large portion of the outlet was constructed, and the excavation was nearly completed for the pipe trench and the south road approach. Exceptionally high water in June, 1916, carried out the temporary suspension footbridge at the site and the pile trestle bridge a short distance below the site, materially handicapping the work.

Proposals were received at Denver on January 24, 1916, for furnishing and erecting the two 110-foot steel-bridge spans which will support the wood-stave pipe and serve also as a highway bridge at Sun River crossing. The work was awarded to the Des Moines Bridge & Iron Co., of Des Moines, Iowa; the contract price is $7,000 for the bridge, f. o. b. Des Moines, and $2,000 for the erection. At the close of the fiscal year the bridge steel had been fabricated and delivered at Gilman, and about 38 per cent of it delivered at the site, but high water and heavy roads have delayed the hauling and erection.

Proposals were received on March 20, 1916, for furnishing and erecting the 96-inch wood-stave pipe for Sun River Crossing. One bid was received and was rejected, as it appeared sufficient time had not been allowed bidders to obtain quotations on materials for the pipe. Specifications 329 were reissued, requesting proposals on May 5, 1916. The Pacific Tank & Pipe Co. was the lowest bidder under the advertisement, and its proposal was accepted for redwood pipe; the contract price is $7,800 for the pipe erected. The required time of delivery of the material is August 15, 1916.

In May, 1916, a small Government force began the repair of the Sun River Slope Canal, Greenfields division, at about mile 2.5. The material underlying the canal embankment at this point is rock having open seams through which surface water entered and undermined the embankment. One large slide was refilled and several cut-off trenches were excavated in the rock and refilled with selected puddle.

LATERAL SYSTEM, GREENFIELDS DIVISION.

On July 1, 1915, contract 615, with O'Connor & Helean, for the excavation of the Greenfields, South Greenfields, and Mill Coulee main laterals, was about 46 per cent completed. The contractor continued work with a force of about 60 teams and completed the contract on November 6, 1915, to which date the contract time had been extended.

Proposals were received July 1, 1915, for the construction of laterals and structures for the first unit, Greenfields distribution system. Eight bids were received on all or parts of the work, and the work was awarded to the lowest bidders, as follows: Schedules 1 to 5, excavation of laterals, to J. E. Hilton, of Billings, Mont., at an estimated amount of about $46,500; schedules 6 to 9, structures, except highway bridges, to the West Coast Construction Co. & Hans Pederson, of Seattle, Wash., at an estimated amount of about $66,000; and schedule 10, highway bridges, to Threet Bros. & Jolley, of Lovell, Wyo., at an estimated amount of about $7,500.

Contract 649 with the West Coast Construction Co. & Hans Pederson, dated September 2, 1915, provided for completion on or before June 30, 1916. At the end of the fiscal year about 18 per cent of the work had been completed. Extension of time has been granted to July 26, 1916.

Contract 650, with Threet Bros. & Jolley, dated August 30, 1915, provided for completion on or before June 30, 1916. Construction of concrete bridge piers was begun early in October and continued until December, when it became necessary to suspend such work on account of cold weather. A small force was employed during the winter on the erection of the bridges. As soon as frost was out of the ground in the spring excavation and the placing of concrete were resumed. At the end of the fiscal year the contract was 98 per cent completed. An extension of time has been granted to July 24, 1916.

Contract 654, with J. E. Hilton, dated September 18, 1915, provided for the completion of the work on or before June 30, 1916. The contractor began work early in September with a force of about 35 teams, increasing this later to about 55 teams, and continued work until stopped by frost late in December. Resuming work late in March, 1916, he continued with about the same force as in the fall of 1915, though at times as many as 75 teams were working. Good progress was made on the work considering the late start made in the fall. At the end of the fiscal year the work was 75 per cent completed. Extension of time has been granted to July 24, 1916.

SEEPAGE AND DRAINAGE.

In the Fort Shaw unit, which contains a total irrigable area of 16,322 acres, about 2,200 acres are affected by seepage to such an extent as to prevent profitable cultivation. No drainage works have been constructed nor have any definite designs for drainage works been made. On March 28, 1914, the Fort Shaw Water Users' Association passed a resolution requesting that the United States take no further action in connection with the construction of drainage works until formally requested by the water users. Since then no further work has been done other than the determination of seeped and alkalied areas.

OPERATION AND MAINTENANCE.

FORT SHAW UNIT.

The irrigation season on the Fort Shaw unit for the year 1915 extended from May 1 to October 10, inclusive. Portions of the project that have been unable to secure suitable stock and domestic water through any other source were given a supply of water through the canal system; delivery of water for such purpose began April 25 and continued until October 27. Another short run was made from November 16 to 19, inclusive, in order to enable the farmers to store a supply of water for winter use. The Fort Shaw main canal and all principal laterals and sublaterals were operated. A number of laterals and sublaterals, not used in 1914, were operated in 1915. No breaks of importance occurred in canal banks. Water was delivered to 164 farm units. The total amount diverted was 15,538 acre-feet and that delivered to farms 4,653 acre-feet. As a result of the unusually large rainfall during the season the amount of water delivered was only 1.1 acre-feet per acre of land irrigated, compared to 1.73 acre-feet per acre delivered during the season of 1914.

Beginning with the irrigation year 1915, operation and maintenance charges were determined in part on the basis of the quantity of water used. The charges for the season 1915 became due March 1, 1916. For each acre of irrigable land, whether irrigated or not, a minimum operation and maintenance charge of 90 cents was made, which entitled the water user to not more than 1 acre-foot of water per acre of irrigable land in the farm unit. For any additional water used an additional charge of 75 cents per acre-foot was made. On account of the unusually wet season only about 7 per cent of the water users used an amount in excess of that to which they were entitled without additional payment.

Deliveries of water to any farm unit were made during the periods and in the quantities requested by the water user, the quantities being limited only by the capacity of the lateral or the size and condition of the farmer's head ditch. The period of delivery to individual farm units varied from one-half day to 16 days and the quantity delivered from about one-half to 4 second-feet. The unusual amount of precipitation occurring during the months that in this locality usually are dry reduced the necessity of water for irrigation to such an extent as to require only about 60 per cent of the capacity of the canal system in order to supply the maximum demand. About 16,000 acre-feet of water were stored in Willow Creek Reservoir, but as the supply of water in Sun River was ample for all requirements no stored water was used and all water was discharged from the reservoir at the end of the operation season.

The early spring of 1916 was dry, and irrigation which began May 6 became general by the middle of the month, increasing until the 21st, at which time the canal was operated at about one-half capacity. A heavy rain and snow storm on May 24 and 25 resulted in the discontinuance of irrigation operations during the remainder of the month. During the early part of June the canal was utilized for a short time to about three-fourths capacity.

Owing to heavy rains and melting snow in the mountains the Sun River overflowed its banks during the latter part of June, doing much damage to crops, fields, and ditches, and threatening permanent damage by forming new channels, thereby isolating areas of farm land in the bottoms. On June 21 the flood reached the highest stage within the memory of the earliest inhabitants. During the period of highest water it was necessary to protect the river bank and the backfill at the headworks structure of the Fort Shaw Canal in order to prevent serious damage. The headworks structure and the main canal sustained practically no damage from the flood, the damage to the system being confined to earthwork on three principal laterals and their sublaterals.

The outlet gate of Willow Creek Reservoir was closed March 22, 1916, and the storage of water begun. On June 19, on account of the excessive run-off of Willow Creek, the outlet gate, which has a circular opening 4 feet 6 inches in diameter, and which to this time had been closed, was raised 34 inches. On the following day it was raised an additional 6 inches. During the night of June 19 the opening was increased to 48 inches, and this opening was retained throughout the remainder of the month of June. The water in the reservoir reached the maximum stage of 4,132.5 feet, corresponding to a storage of 19,600 acre-feet on June 30. The average discharge of Willow Creek into the reservoir for a 9½-hour period on June 22 was 3,600 second-feet, and at no time for 10 days did the flow fall below about 550 second-feet. The maximum flow, heretofore recorded, was 560 second-feet.

During the latter part of 1915 maintenance work, which consisted chiefly in placing dry paving and raising lateral banks, was done largely by ditch riders. A number of measuring devices were installed. In the spring a crew placed rock paving for channel protection in stretches of the main canal, replaced worn-out structures, cleaned laterals, and performed other miscellaneous repair work.

Historical review, Sun River project.

Item.	1910	1911	1912	1913	1914	1915	1916, to June 30.
Acreage for which service was prepared to supply water	16,000	16,346	16,346	16,346	16,346	16,346	16,322
Acreage irrigated	4,194	6,892	6,824	7,419	6,613	4,261	2,271
Miles of canal operated	105	121	121	121	110	100	85
Water diverted (acre-feet)	30,499	24,192	20,392	20,566	24,762	15,538	5,017
Water delivered to land (acre-feet)	9,707	11,380	11,688	11,187	11,468	4,653	1,896
Per acre of land irrigated (acre-feet)	2.30	1.65	1.71	1.50	1.73	1.10	0.83

SETTLEMENT.

During the fiscal year there were five homestead entries made under the reclamation act, one relinquishment, four assignments, and three transfers of title; no cancellations were made. A number of new units have been brought under cultivation during the past year and the cultivated area of other units has been increased. Farming on the Fort Shaw unit is essentially a dairy or stock-raising proposition, and the increase in the number and the improvement in the grade of horses, cattle, and hogs are encouraging. As the new units and adjacent dry-land farms are being fenced, some difficulty is experienced by the farmers in finding sufficient range for their stock during the summer months.

There is little noticeable change in the population of the towns on the project. As trading centers, however, their importance is gradually becoming more fixed and business in general is increasing. At Fort Shaw a grain elevator has been erected, and the Equity Cooperative Association has established a branch store and is handling produce and conducting a general mercantile business.

Settlement data, Fort Shaw unit, Sun River project.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	196	195	199	270	265
Population			523	590	[1] 600
Number of irrigated farms	176	179	172	200	204
Operated by owners or managers	146	141	159	126	[1] 132
Operated by tenants	30	38	13	74	[1] 72
Population			490	565	[1] 575
Number of towns	3	3	3	3	3
Population			203	173	[1] 210
Total population in towns and on farms			726	739	[1] 785
Number of public schools	4	4	4	4	4
Number of churches	1	3	3	3	4
Number of banks			1	1	1
Total capital stock			$20,000	$20,000	$20,000
Total deposits				$44,000	$61,000
Total depositors				300	264
Number of relinquishments	4	6	3	6	1
Number of cancellations	5	1	5	3	
Homestead entries		6	4	13	5

[1] Estimated.

PRINCIPAL CROPS.

Considering the units in the Fort Shaw unit using water in the years 1914 and 1915, there was an increase of $1.04 per acre in the average crop value for 1915 compared to that for the previous year. The total area in crop in 1915 was 7,504 acres, which was an increase of 625 acres over that of 1914. The gross value of crops produced in the Fort Shaw unit amounted to $127,388.47. Alfalfa was the principal crop, there being 3,873 acres, or about 52 per cent of the cultivated area, in that crop. Other crops of importance were oats, wheat, barley, and potatoes. On units using water the increased yield of potatoes was 39 per cent and of oats 18 per cent. On account of the unusually large amount of rainfall in July, 1915, which amounted to 6.33 inches, the first cutting of alfalfa was badly damaged, and the quantity of marketable hay was less than in 1914. Prices of farm products were as follows: Baled alfalfa, $7 to $13 per ton; wheat, 75 cents to $1.10; oats, 38 to 52 cents; barley, 48 to 60 cents; and potatoes, 30 to 75 cents per bushel. Farmers who engaged in stock feeding realized the best returns from their crops. The spring of 1916 has been cold and backward, but the crop outlook for the season is encouraging.

Crop report, irrigated farms, Sun River project, Fort Shaw unit, Montana, year of 1915.

Irrigated crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa hay	3,706	Tons	7,888	2.1	$6.00	$46,868	$12.65
Alfalfa seed	34	Bushels	53	1.6	12.04	638	18.76
Apples	2	Pounds	3,300	1,700	.03	97	48.50
Barley	245	Bushels	6,946	28	.64	4,438	18.08
Beans	2	...do	20	10	.50	59	33.43
Beets, sugar	2	Tons	22	11	5.00	110	55.00
Clover hay	9	...do	15	1.7	8.00	117	13.00
Indian corn	1	Bushels	20	20	.60	12	12.00
Corn fodder	5	Tons	15	3	5.93	89	18.00
Fruits, small	3					1,055	301.45
Garden	79					7,947	100.60
Hay, except above	279	Tons	240	.86	8.36	2,007	7.21
Millet seed	3	Bushels	75	25	.80	60	20.00
Oats	1,033	...do	36,269	35	.45	16,321	15.80
Onions	2	...do	717	358	1.21	869	434.62
Pasture	213					2,245	10.54
Peas	5	Bushels	115	23	1.25	144	28.75
Potatoes, white	147	...do	27,673	188	.50	13,837	94.13
Rye	4	...do	56	14	.65	36	9.10
Wheat	891	...do	19,351	22	.94	18,180	20.39
Total cropped acreage.	[1] 6,665	Total and average				115,129	17.29

		Areas.	Acres.	Farms.	Per cent of project.
Irrigated, no crop	18	Total irrigable area farms reported	9,026.78	164	55.3
Total irrigated acreage	[1] 4,261	Total irrigable area farms reported (less temporary deductions on account of seepage, etc.)	8,032.85	164	49.2
		Total irrigated area farms reported:			
		Under water-right applications	4,116.80	160	25.2
		Under rental contracts	126.50	4	.7
		Total cropped area farms reported	6,665.00	164	40.8

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[1] On 164 units using water, 4,243 acres irrigated and cropped; 2,422 acres cropped without irrigation. An additional 18 acres irrigated on United States reserves, town sites, etc., without crop.

Crop report, units farmed "dry," Fort Shaw unit, Sun River project, Montana, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	167	Tons	304	1.8	$6.00	$1,825	$10.90
Barley	47	Bushels	1,019	21.68	.60	611	13.01
Clover hay	6	Tons	6	1	6.00	36	6.00
Flax	8	Bushels	108	13.50	1.60	172	21.50
Garden	9	Acres			88.57	775	88.57
Hay, except above	119	Tons	138	1.15	6.92	955	7.97
Oats	169	Bushels	5,895	34.9	.45	2,653	15.70
Pasture	80	Acres			2.00	160	2.00
Potatoes, white	13	Bushels	2,452	188.2	.50	1,226	94.32
Wheat	221	...do	4,047	18.4	.95	3,845	17.44
Total cropped acreage.	839	Total and average				12,258	14.60

Areas.	Acres.	Farms.	Per cent of project.
Irrigable area farms reported	1,099.47	31	6.6
Cropped area farms reported	839.25	31	5.1

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, JANUARY 15, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, notice is hereby given that hereafter until further notice for all lands under the Fort Shaw unit, Sun River project, Montana, the operation and maintenance charge for any irrigation season shall be due and payable on March 1 of the following calendar year.

2. The operation and maintenance charges for the irrigation season of 1916 and for each irrigation season thereafter until further notice shall be due March 1 of the following year, and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of $1.10, which will permit delivery of not more than 1½ acre-feet per acre, and should further quantities be needed, they will be furnished at the rate of 50 cents per acre-foot.

3. The provisions of this public notice cover all lands subject to public notice heretofore issued for the said project.

4. Except as hereinabove provided, all the terms and provisions of existing puplic notices and orders, and in particular the public notice of March 26, 1915, for the Fort Shaw unit shall remain unchanged.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 713.]

Feature costs of Sun River project to June 30 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys		$48,115.71
Storage system:		
Warm Springs site	$32,719.33	
Bowl Creek diversion	1,776.15	
Basin Creek diversion	41.98	
Beaver Creek site	16,757.47	
Willow Creek storage	268,736.07	
Pishkun Reservoir	1,916.51	
Muddy Creek Reservoir	3.27	
Benton Lake Reservoir	1,176.89	
Administrative general expense	2,244.74	
		325,372.41
Canal system:		
Fort Shaw Canal	233,088.52	
Pishkun Reservoir Supply Canal	1,119,732.25	
Sun River Slope Canal—		
Spring Valley division	615,527.17	
Greenfields division	162,992.98	
Teton River Slope Canal	19,719.76	
Greenfields Lake Canal	101.92	
Healey Buttes Canal	449.85	
Sunnyside Canal	1,732.09	
Administrative general expense	8,903.32	
		2,162,247.86
Lateral system:		
Fort Shaw Canal	206,362.21	
Teton River Slope Canal	454.17	

Feature costs of Sun River project to June 30, 1916—Continued.

Features.	Subfeature.	Principal feature.
Lateral system—Continued.		
Sun River Slope Canal—		
Spring Valley unit	$1,294.96	
Greenfields first unit	187,079.62	
Greenfields second unit	357.32	
Administrative general expense	9,453.25	
		$405,001.53
Farm units:		
Fort Shaw	3,052.46	
Sun River Slope Canal—		
Greenfields first unit	7,613.02	
Greenfields second unit	762.25	
Administrative general expense	998.51	
		12,426.24
Permanent improvements and lands:		
Buildings	15,838.43	
Roads	34,154.45	
Real estate and permanent improvements	23,044.13	
Administrative general expense	864.42	
		73,901.43
Telephone system		22,260.08
Plant account		42,475.48
Operation and maintenance charges transferred to and compounded with construction charges		2,810.71
Gross construction cost of Sun River project to June 30, 1916		3,094,611.45
Less revenues earned during construction period:		
Rental of buildings	11,234.57	
Rental of grazing and farm land	7,590.71	
Rentals and tolls, telephone	301.65	
Contractors' freight refunds	16,027.97	
Sale of town-site lots	8,268.19	
Other revenues unclassified	21,282.05	
Profits on mess-house operations	4,716.47	
Profits on mercantile-store operations	2,885.11	
Profit on hospital deductions	771.85	
		73,078.57
Net cost of construction of project to June 30, 1916		3,021,532.88

Estimated cost of contemplated work, Sun River project, during the fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examination and surveys:		
Cooperative gaging by United States Geological Survey	$1,500	
Reconnaissance surveys	2,200	
Examination of lands	300	
		$4,000
Storage works:		
Sun River storage—Investigations	7,070	
Willow Creek Dam	1,750	
Pishkun Reservoir	2,550	
		11,370
Canal system:		
Pishkun Supply Canal	33,160	
Sun River Slope Canal—		
Spring Valley division	4,340	
Greenfields division	2,060	
		39,560
Lateral system:		
Greenfields first unit	131,500	
Greenfields second unit	10,200	
		141,700
Farm units—Greenfields distribution system		3,500
Permanent improvements and land:		
Sun River Crossing—Bridge and road	5,100	
Operation and maintenance road along North Side canals	5,700	
		10,800
Telephone system:		
Willow Creek Reservoir to North Side lines	700	
Greenfields first unit	4,600	
		5,300
Operation and maintenance during construction—Greenfields first unit		5,870
Operation and maintenance—Public notice, Fort Shaw unit		10,600
Messes	4,000	
Hospitals	200	
Mercantile stores	100	
		4,300
		237,000

MONTANA-NORTH DAKOTA, LOWER YELLOWSTONE PROJECT.

L. H. MITCHELL, project manager, Savage, Mont.

LOCATION.

Counties: Richland and Dawson, Mont.; McKenzie, N. Dak.

Townships: 18 to 26 N., Rs. 56 to 60 E., Montana meridian; 150 to 152 N., R. 104 W., fifth principal meridian.

Railroads: Northern Pacific, Great Northern, and Missouri River.

Railroad stations and estimated population January 1, 1916: Intake, 75; Burns, 25; Savage, 275; Crane, 40; Sidney, 1,100; and Fairview, Mont., 600; Dore, N. Dak., 30.

WATER SUPPLY.

Source of water supply: Yellowstone River.

Area of drainage basin: 66,000 square miles.

Annual run-off in acre-feet: Yellowstone River at Intake, Mont., 1915, 10,423,000; maximum since 1909, 13,200,000; minimum since 1909, 8,900,000.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to deliver water, season of 1916: 42,300 acres.

Area under rental contracts, season of 1916: 27,798 acres.

Area under water-right applications, season of 1916: 2,485 acres.

Length of irrigating season: May 1 to October 10—163 days.

Average elevation of irrigable area: 1,900 feet.

Rainfall on irrigable area: 10-year average, 15.9 inches; 1915, 17.72 inches.

Range of temperature on irrigable area: —46° to 110° F.

Character of soil of irrigable area: Deep sandy loam predominates, some alkali and gumbo.

Principal products: Grain, forage crops, and vegetables.

Principal markets: Minneapolis, St. Paul, and Duluth, Minn.; local markets consume forage crops and vegetables.

LANDS OPENED FOR IRRIGATION.

Dates of public notices and orders: December 21, 1908; March 7, March 24, May 1, August 28, and November 8, 1911; March 1 and April 30, 1912; February 26, May 28, June 23, and July 21, 1913; January 19, March 4, and September 24, 1914; February 5, March 2, March 17, and March 20, 1915; January 29, March 16, and April 12, 1916.

Location of lands opened: Tps. 18 and 19 N., R. 57 E.; Tps. 19 and 20 N., R. 58 E.; Tps. 21, 22, 23, 24, and 25 N., R. 59 E.; and T. 24 N., R. 60 E., Montana principal meridian; Tps. 150 and 151 N., R. 104 W., fifth principal meridian.

Present status of irrigable area opened: 8,968 acres entered subject to the reclamation act; 167 acres open to entry; 1,068 acres State land; 31,812 acres private land.

Limit of area of farm unit: Public, 80 acres; private, 160 acres.

Duty of water: 2½ acre-feet per acre per annum at the farm.

Building charge per acre of irrigable land: $42.50 and $45; rental charge for 1916, 50 cents per acre for 1½ acre-feet; additional water at the rate of 50 cents per acre-foot.

Annual operation and maintenance charge: 75 cents per acre for 1 acre-foot; additional water at the rate of 50 cents per acre-foot.

CHRONOLOGICAL SUMMARY.

Reconnoissance made and preliminary surveys begun in 1903.
Construction recommended by board of engineers, April 23, 1904.
Construction authorized by Secretary, May 10, 1904.
Lower Yellowstone Dam completed, February 19, 1910.
First irrigation by Reclamation Service, season of 1909.
Entire project 87 per cent completed, June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Lower Yellowstone project provides for the diversion of water from the Yellowstone River at a point 18 miles below Glendive, Mont., into a canal on the west side of the river which extends down the valley to the confluence of the Yellowstone and Missouri Rivers, conveying water for the irrigation of land lying between the canal and the Yellowstone River. The fall of the water which will be discharged from the main canal into lateral KK at a point 19 miles below the headgates will be utilized to operate turbines direct connected to centrifugal pumps for raising water to irrigate approximately 3,000 acres of excellent bench land.

The completed features are the Lower Yellowstone Dam and diversion works, the main canal for a distance of 66.4 miles, and the complete lateral system in connection therewith. Sublaterals and extensions of a few main laterals will be constructed as the needs of water users require.

The features for future construction are the pumping plant, the remaining 5 miles of the main canal, and about 52 miles of laterals, which, when completed, will irrigate approximately 15,500 acres.

SUMMARY OF GENERAL DATA FOR LOWER YELLOWSTONE PROJECT TO JUNE 30, 1916.

Areas:	
Irrigable acreage when project is complete	60, 116
Public land entered, June 30, 1916	15, 992
Public land open to entry, June 30, 1916	167
Public land withdrawn, June 30, 1916	1, 698
State land, June 30, 1916	1, 653
Private land, June 30, 1916	40, 606
Acreage service could have supplied season of 1915	42, 300
Estimated acreage service can supply July 1, 1917	42, 300
Acreage actually irrigated, season of 1915	12, 656
Acreage cropped under irrigation, season of 1915	11, 990
Acreage dry farmed and cropped, season of 1915	10, 466
Crops:	
Value of irrigated crops, season of 1915	$194, 011. 00
Value of irrigated crops per acre cropped	$16. 18
Value of dry-farmed crops, season of 1915	$107, 588. 00
Value of dry-farmed crops per acre cropped	$10. 30
Finances:	
Estimated cost of completed project	$3, 332, 751. 65
Total construction cost to June 30, 1916, including supplemental construction	$2, 893, 218. 48
Per cent complete June 30, 1916, including supplemental construction	87
Appropriation for fiscal year 1917, total for operation and maintenance	$30, 000. 00
Estimated per cent complete June 30, 1917	87
Announced construction charges per acre	$45. 00 and $42. 50
Supplemental construction cost to June 30, 1916	62, 829. 73
Appropriation, fiscal year 1916	$70, 000. 00

Expenditures during fiscal year chargeable to 1916 appropriation:			
Disbursements	$21,246.13		
Transfers	2,695.14		
		$23,941.27	
Registered liabilities chargeable to 1916 appropriation		2,648.17	
			$26,589.44
Unencumbered balance July 1, 1916			$43,410.56
Repayments:			
Construction charges—			
Accrued to June 30, 1916			$67,770.53
Collected to June 30, 1916			$9,979.25
Uncollected June 30, 1916			$57,791.28
Operation and maintenance charges (public notice)—			
Accrued to June 30, 1916			$138,453.74
Collected to June 30, 1916			$35,735.23
Uncollected June 30, 1916			$102,718.51
Water-rental charges—			
Accrued to June 30, 1916			$27,176.94
Collected to June 30, 1916			$21,836.72
Uncollected June 30, 1916			$5,340.22
Drainage:			
Estimated acreage damaged by seepage to June 30, 1916			1,300
Miles of drains built to June 30, 1916, open			5.6
Estimated acreage protected by drains built to June 30, 1916			1,600
Estimated acreage to be protected by authorized system			1,600
Expended, to June 30, 1916, on drainage works completed and uncompleted			$62,079.73

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

MAIN CANAL AND LATERALS.

The main canal of the Lower Yellowstone project heads on the north bank of Yellowstone River about 18 miles below Glendive. It has a capacity of 830 second-feet and is built on the low grade of approximately 6 inches to the mile for the first 46 miles. There is much heavy construction work in the first 25 miles, and the excava-which are frequent at this point. The structures on the main canal are of concrete, built with heavy gravity section to resist ice gorges, which are frequent at this point. The structures on the main canal are built of reinforced concrete, the most important being the crossings of the wide cross-drainage channels. The larger streams are crossed by box-shaped conduits on grade or by siphons, the smaller streams by culverts under and flumes over the canal.

During the winter of 1904–5 plans for the first four divisions, about 34 miles of the main canal, were prepared. These plans were examined and approved in March, 1905, by a board of engineers consisting of Messrs. J. H. Quinton, A. J. Wiley, and H. N. Savage. Proposals for this portion of the canal, including earthwork and structures, submitted under specifications No. 31, were opened on June 1, 1905.

A contract for the earthwork on division 1 was entered into on July 22, 1905. This contract was suspended in March, 1906, when it was 29.2 per cent completed, on account of the insolvency of the contractors. Proposals for the remainder of the work under this contract were opened on May 3, 1906, and a contract therefor was executed on June 4, 1906. The work was completed on March 7, 1909.

A contract for the earthwork on divisions 2, 3, and 4 of the canal was executed on July 21, 1905. On account of advances in the prices of material and labor, the contractors refused to begin work, and the contract was therefore suspended. After readvertisement a contract for division 2 was executed on May 12, 1906, and the work was completed on May 15, 1908. A contract for division 4 was executed April 30, 1906, and completed on September 30, 1908. No proposals for division 3 were received, but a contract was executed on informal proposals July 26, 1906, and the work completed on August 21, 1908.

A contract for the structures on divisions 1, 2, and 3 was executed on July 24, 1905, work was begun in August, 1905, and the contract was assumed by the original contractors' sureties on October 26, 1906. A supplementary contract was entered into on January 10, 1910, eliminating the Linden Creek flume and Nelson Slough sluiceway from the contract. Work under the supplementary contract was completed on November 4, 1908. The Linden Creek flume and sluiceway were readvertised under informal specifications, and proposals were opened on March 28, 1908. All proposals received were rejected, but a satisfactory informal proposal was received later, and a contract was awarded on May 15, 1908.

On November 15, 1905, proposals under Specifications No. 60 for the earthwork on divisions 5 to 9 of the main canal and on the lateral system were opened. The work on divisions 5, 6, 7, and 9 of the main canal and on laterals A to M, except F, was contracted for in December, 1905, but the contracting company went into the hands of a receiver before work was commenced. A new contract was entered into on behalf of the sureties on April 20, 1906, division 9 of the main canal being eliminated from the contract by agreement, and the work was completed on September 30, 1908. Lateral N was contracted for on December 16, 1905, and completed September 25, 1907. Division 8 of the main canal and laterals F, O, and P were contracted for soon after the opening of proposals, but the contracting company passed into the hands of a receiver in February, 1906, making necessary the suspension of the contract. A new contract on behalf of the sureties was entered into on May 1, 1906, and the work was completed on July 31, 1908.

Proposals for the structures on divisions 5 to 9 of the main canal and on laterals A to P, inclusive, were requested for opening on April 12, 1906. No proposals were received, and the contractor for the structures on division 4 of the main canal was asked to submit an informal proposal for the work. A contract was executed on August 7, 1906, and the building of the structures was completed on December 28, 1908, the structures on divisions 8 and 9 having been previously eliminated from the contract by agreement. Proposals for the construction of laterals and waste-water ditches from the main canal headworks to Newlon and for structures were opened on December 15, 1906. No satisfactory proposals were received, and the work was eventually executed under informal contracts, being completed in December, 1908. A dam at Nelson Slough to protect the bank of the main canal was built under informal contract, the work being completed on December 24, 1907. Three reinforced concrete flumes and a number of culverts, turnouts, and other small structures between the headworks and Newlon were built by Government forces.

During the fiscal year 1910 work under several minor contracts, for the construction of small laterals, waste-water ditches, etc., was carried on and some similar work was done by Government forces.

Petitions were received during the summed of 1911, signed by about 50 landowners adjacent to the irrigated land, requesting that the canals be extended to their holdings. Proposals for this work were opened August 9, 1912. Schedule 1, covering the extension of 4.6 miles of lateral K; schedule 2, covering 4.7 miles of main canal and 4.9 miles of lateral Q system; and schedule 3, providing for extension of lateral D for 1.3 miles, were awarded under separate contracts. No bids were received for schedule 4, covering the structures on the above extensions, and the work was done by Government forces. The work on the above schedules was completed in the spring of 1913.

Minor construction carried on under operation and maintenance consisted of small lateral extensions, installation of lateral-checks, farm turnouts, and bridges and culverts on road crossings.

LOWER YELLOWSTONE DAM.

Lower Yellowstone Dam is a rock-filled timber crib weir on a pile foundation. It is 700 feet long and raises the water level of the river about 5 feet. The dam is specially designed to resist ice action, having an upstream slope of 3 to 1, an ogee downstream face, and a heavy rock apron.

Proposals for the construction of the dam were opened on December 5, 1905. The bids were considered excessive, and the proposals were rejected. The work was readvertised, and proposals were opened on May 10, 1906. The lowest bidder was unable to give satisfactory bond, and the work was offered to the next lowest bidder. This firm refused to execute a contract, and the work was finally awarded to the third lowest bidder. The contract, which included the dam proper, the concrete abutments at the south end of the dam, and the dike from this abutment to a small hillock on Joes Island, was executed on September 21, 1906, and construction was begun late in the fall of 1906. Following a controversy in regard to changes in the materials of construction, the contractor discontinued operations, the contract was suspended on September 15, 1908, and the construction of the dam was undertaken by Government forces. Construction was completed on Februry 19, 1910.

No construction work was carried on during the past fiscal year.

SEEPAGE AND DRAINAGE.

The total area on the project that has become unfit for cultivation due to seepage, since the opening of the project in 1909, is 1,239 acres. This area has not varied materially during the past three years. Seepage is increasing in some localities and decreasing in others. Limited areas of water-logged land have been reclaimed as the result of proper irrigation and cultivation, and a few tracts adjacent to constructed drains have shown improvement as a result of lowering of the ground-water table.

Drainage line No. 1 was projected to relieve about 500 acres of water-logged land immediately north of Sidney, and to protect a total area of about 2,500 acres. The plans for this line contemplated 5 miles of closed drain and 2 miles of deep, open drain. Construction was begun on August 5, 1913, and suspended December 12, 1914, when 5.37 miles had been excavated. The completion of drain line No. 1 and the construction of other necessary drains are dependent on an increased construction charge to cover the cost of drainage.

OPERATION AND MAINTENANCE.

The canal system of the Lower Yellowstone project consists of 66.3 miles of main canal and 146.6 miles of laterals. The irrigable lands reached by this canal system stretch along the Yellowstone River from Intake, Mont., to the Missouri River, and vary in width from one-half mile, or less, at the upper end to 5 miles in the Fairview district.

Water was turned into the main canal on April 22, 1915, for the purpose of sluicing out weeds. This continued for several days, the weeds being turned out at each sluiceway along the canal for a sufficient length of time to enable the water to run clear. The first delivery was made on April 29 and the last on October 10. The water was turnd out for two periods of 10 days each in September, leaving 151 days of actual canal operation.

The canal system as constructed provided for the irrigation of 42,329 acres, not including lands under the pumping unit, which is only partly completed, but including lands which are temporarily exempt from water charges, such as timber and brush and water-logged areas. The total acreage for which crop and other statistics are gathered comprises all lands covered by rental or water-right applications, including delinquents. For the season of 1915 this amounted to 389 farms.

Water was delivered to 260 farms with an irrigable area of 21,833 acres, of which 12,656 acres, or 57 per cent, were irrigated. This amounted to an average of 49 acres irrigated per farm, and 35 acres dry farmed. Considering the total of 389 farms, the irrigated area per farm is 32 acres, with 47 acres dry farmed. The following statistics give results for Montana and North Dakota:

	Montana.		North Dakota.		Total.	
	Farms.	Area (acres).	Farms.	Area (acres).	Farms.	Area (acres).
Water available for	401	30,995	110	11,334	511	42,329
Under rental and water right	302	22,213	87	8,300	389	30,513
Lands irrigated	195	8,560	65	4,096	260	12,656

A total of 163 miles of canals were in use or operated during the season. The main canal was operated for its entire length of 66.3 miles, and 96.7 miles of laterals were in use at various times; 38 miles of laterals that were available for the distribution of water were not operated as the adjacent land owners made no requests for water. Only 30 per cent of the land for which water was available was actually irrigated, and the delivery of this water required the operation of 81 per cent of the available canals.

Historical review, Lower Yellowstone project.

Item.	1911	1912	1913	1914	1915	1916 to June 30.
Acreage for which service was prepared to supply water	37,867	37,880	37,799	36,250	42,300	42,300
Acreage irrigated	15,445	5,068	7,660	5,743	12,656	1,582
Miles of canal operated	158	125.5	133	151	163	138
Water diverted (acre-feet)	52,542	15,404	30,088	25,769	40,141	....
Water delivered to land (acre-feet)	21,799	6,058	10,250	9,143	17,970	1,375
Per acre of land irrigated (acre-feet)	1.41	1.19	1.34	1.59	1.42	0.87

SETTLEMENT.

The prosperity of irrigation farmers, where sugar beets and fruit can not be raised, depends upon the acreage of alfalfa. When comparing the 6,055 acres in alfalfa with the total irrigable area of 42,329 acres, it would appear at first that the settlers on the Lower Yellowstone project are neither progressive nor prosperous. However, after considering the fact that the acreage in alfalfa increased nearly 50 per cent during 1915, and that the increase in the value of stock was $70,000, it can be taken for granted that the settlers are endeavoring to make good.

Thirteen transfers of land in private ownership and four assignments of land entered subject to the reclamation act were made during the year. In all these transfers only two additional farmers were obtained.

On January 1, 1915, there were eight homesteads, comprising 355 acres, open to entry. During the year an entry of 69 irrigable acres was canceled, due to nonpayment of charges. One entry of 75 irrigable acres was entered.

Settlement data, Lower Yellowstone project.

Item.	1913	1914	1915[1]	1916[2]
Total number of irrigable farms on project	456	512	514	514
Population	600	700	821	821
Number of irrigated farms	158	184	260	260
Irrigable farms operated by owners	191	140	168	168
Irrigable farms operated by tenants	21	153	62	62
Irrigable farms with neither owners nor tenants thereon	136	171	159	159
Number of towns	7	8	8	8
Population	1,125	1,750	2,145	2,145
Total population in towns and on farms	1,725	2,450	2,966	2,966
Number of public schools	15	16	19	19
Number of churches	4	4	5	5
Number of banks	7	9	9	9
Total capital stock of banks	$200,000	$230,000	$230,000	$230,000
Total amount of deposits of banks	....	$715,000	$908,000	$1,388,000
Total number of depositors of banks	....	3,600	3,838	5,637
Number of relinquishments	2	2	3	1

[1] Project on rental basis.

[2] To June 30; project on rental basis.

PRINCIPAL CROPS.

Wheat and alfalfa continue to be the principal crops raised in the valley. The total area planted to wheat was 8,488 acres, or 2,576 acres more than in 1914. The average yield, however, was 0.6 bushel less. Irrigated wheat yielded 18.2 bushels per acre, and the dry crop averaged 12.5 bushels. The price locally ranged from 70 cents per bushel in October to $1.10 per bushel in January, 1916; but most of the project wheat was sold for an average of about 90 cents per bushel.

Alfalfa acreage increased from 4,180 acres in 1914 to 6,055 acres in 1915, or 45 per cent. This crop yielded an average of 2.3 tons per acre, and brought from $5 to $10 in the stack. The project alfalfa is consumed locally and the price is dependent on local conditions. Early in the fall a few farmers who felt that there would be little demand for forage sold at the low figure. After some 14,000 feeder sheep were shipped into the valley prices began to rise, and before the close of November $10 per ton was being offered quite freely.

Since the statistics for succeeding years include additional farms brought under irrigation the increase in certain crop areas is not a true indication of conditions. The following table will give a clearer idea of crop conditions on the project:

Percentage of total crop acreage.

Year.	Wheat.	Alfalfa.	Oats.	Barley.	Flax.	Total.
1913	42	12	14	12	7	87
1914	26	18	16	11	10	81
1915	38	27	15	6	5	91

Crop report, irrigated lands, Lower Yellowstone project, Montana-North Dakota, year of 1915.

Irrigated crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	4,404	Tons	10,283	2.3	$7.74	$79,567	$18.07
Alfalfa, first year	171	...do	29	.2	7.04	204	1.19
Barley	750	Bushels	21,420	28.6	.43	9,161	12.21
Corn fodder	125	Tons	389	3.1	5.29	2,059	16.47
Flaxseed	273	Bushels	3,108	11.4	1.82	5,659	20.73
Garden	70	....	....	....	....	4,641	66.30
Hay	265	Tons	269	1.0	9.22	2,480	9.36
Oats	1,320	Bushels	49,745	37.7	.29	14,579	11.04
Potatoes	60	...do	5,370	89.5	.57	3,059	50.98
Wheat	4,518	...do	82,444	18.2	.87	71,897	15.91
Miscellaneous	34	....	....	....	....	705	20.74
Cropped acreage	11,990	Total and average				194,011	16.18

Irrigated crop.	Area (acres).	Areas.	Acres.	Farms.	Per cent of project.[1]
Irrigated, no crop:					
Pasture	324	Total irrigable area farms reported	21,833	260	52
Stubble	70	Total irrigated area farms reported	12,656	260	30
Miscellaneous	272	Under water-right applications	45	3	....
		Under rental contracts	12,611	257	30
Total irrigated acreage	12,656	Total cropped area farms reported	18,044	260	43

[1] Based on area for which water is available.

Crop report, unirrigated lands, Lower Yellowstone project, Montana-North Dakota, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	1,341	Tons	1,796	1.3	$7.92	$14,221	$10.60
Alfalfa, first year	139	...do	16	.1	7.94	127	.92
Barley	676	Bushels	15,944	23.6	.41	6,453	9.55
Corn fodder	543	Tons	1,392	2.6	5.12	7,132	13.13
Flaxseed	833	Bushels	5,311	6.4	1.77	9,410	11.30
Garden	36					1,802	50.56
Hay	794	Tons	663	.8	6.69	4,435	5.58
Oats	1,965	Bushels	51,926	26.4	.29	14,873	7.57
Potatoes	104	...do	8,735	84.0	.56	4,843	46.57
Wheat	3,970	...do	49,670	12.5	.89	43,970	11.08
Miscellaneous	45					322	7.15
Total cropped acreage.	10,466	Total and average				107,588	10.30

Areas.	Acres.	Farms.	Per cent of project.
Total irrigible area farms reported	26,137	[1] 321	62
Total cropped area farms reported	18,912	321	45

[1] Includes 192 farms reporting both irrigated and dry crop.

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, JANUARY 29, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, notice is hereby given that hereafter until further notice for all lands under the Lower Yellowstone project, Montana-North Dakota, the operation and maintenance charge for any irrigation season shall be due and payable on March 1 of the following year.

2. The operation and maintenance charges for the irrigation season of 1916 and for each irrigation season thereafter until further notice, shall be due on March 1 of the following year and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of 75 cents, which will permit delivery of not more than 1 acre-foot per acre, and should further quantities be needed, they will be furnished at the rate of 50 cents per acre-foot.

3. The provisions of this public notice cover all lands subject to public notice heretofore issued for the said project, except lands receiving water on a rental basis.

4. Except as hereinabove provided, all the terms and provisions of existing public notices and orders, and in particular the public notice

of March 17, 1915, for the Lower Yellowstone project, shall remain unchanged.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

ORDER, APRIL 12, 1916.

The lands of all entrymen and landowners under the Lower Yellowstone project, Montana-North Dakota, for which water will be available in the irrigation season of 1916, and for which acceptances of the provisions of the orders of March 4, 1914, and February 5, 1915, were not filed within the time specified, may obtain a supply of irrigation water in the season of 1916 and thereafter until further notice, on a rental basis of 50 cents per irrigable acre for the irrigation season, payment thereof to become due December 1 after the close of the irrigation season, provided there shall be filed with the project manager at Savage, Mont., a written acceptance of the terms and conditions of this order and the order of March 4, 1914, and conditioned also upon compliance with the cultivation requirements thereof: *Provided*, That payment be made at the time of acceptance at the rate of 50 cents per irrigable acre for the season of 1915, plus interest at the rate of 10 per cent per annum from December 1, 1915, to the date of such acceptance and payment: *And provided further*, That occupants of lands who are not the owners thereof, but who wish to avail themselves of the conditions of this order, shall pay at the time of acceptance the charges for 1915 plus interest and the charges for 1916. .

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 715.]

Feature costs of Lower Yellowstone project to June 30, 1916.

Features.	Subfeature.	Principal features.
Examination and surveys		$66,006.54
Canal system:		
Diversion dam	$338,396.29	
Canal system	2,069,946.10	
		2,408,342.39
Lateral system		290,819.83
Drainage system, line No. 1		62,079.73
Farm units		1,016.24
Permanent improvements and lands		39,536.38
Telephone system		23,717.32
Operation and maintenance charges transferred to and compounded with construction charges		1,700.05
Gross cost of construction of project to June 30, 1916		2,893,218.48
Less revenues earned during construction period:		
Rental of buildings	422.00	
Rentals of irrigation water	27,176.94	
Rentals of telephones and tolls	4,331.04	
Contractors' frieght refunds	21,261.33	
Loss on mess-house operations	[1] 4,422.69	
		48,768.62
Net cost of construction of project to June 30, 1916		2,844,449.86

[1] Decrease.

Estimated cost of contemplated work on Lower Yellowstone project during fiscal year 1916.

Features.	Amount.
Operation and maintenance under public notice	$29,000
Messes	750
Hospitals	250
Total	30,000

NEBRASKA-WYOMING, NORTH PLATTE PROJECT.

ANDREW WEISS, project manager, Mitchell, Nebr.
O. T. REEDY, construction engineer, Fort Laramie unit, Fort Laramie, Wyo.

LOCATION.

Counties: Sioux, Scotts Bluff, Banner, and Morrill, Nebr.; Natrona, Carbon, Converse, Goshen, and Platte, Wyo.

Townships: 19 to 27 N., Rs. 48 to 67 W.; 26 to 30 N., Rs. 83 to 85 W., sixth principal meridian.

Railroads: Chicago, Burlington & Quincy; Union Pacific; Chicago & North Western; Colorado & Southern.

Railroad stations and estimated population, January 1, 1916: Bridgeport, 700; Bayard, 400; Minatare, 600; Scottsbluff, 3,500; Mitchell, 1,000; Morrill, 600; and Henry, Nebr., 100; Torrington, 700; Vaughn; Lingle, 10; Barnes; Fort Laramie, 75; Whalen; Guernsey, 400; and Casper, Wyo., 5,000.

WATER SUPPLY.

Source of water supply: North Platte River.

Area of drainage basin: 12,000 square miles.

Annual run-off in acre-feet of North Platte River: At Pathfinder, Wyo. (12,000 square miles), 1905 to 1915—Maximum, 2,420,000; minimum, 870,000; mean, 1,411,000. At Guernsey or Whalen, Wyo. (16,200 square miles), 1900 to 1915—Maximum, 2,690,000; minimum, 983,000; mean, 1,578,000.

AGRICULTURAL AND CLIMATIC CONDITIONS.

INTERSTATE UNIT.

Area for which the service is prepared to supply water, season of 1916, 129,891 acres.

Area under water-right applications and rental contracts, season of 1916, 112,698 acres.

Length of irrigating season: From April 1 to September 30—183 days.

Average elevation of irrigable area: 4,100 feet above sea level.

Rainfall on irrigable area: 6 years, average, 15.06 inches; 1915, 22.94 inches.

Range of temperature on irrigable area: —30° to 104° F.

Character of soil of irrigable area: Sandy loam.

Principal products: Alfalfa, cereals, corn, sugar beets, potatoes.

Principal markets: Omaha, Nebr.; Kansas City and St. Joseph, Mo.; Denver, Colo.; central Wyoming.

LANDS OPENED FOR IRRIGATION.

Dates of public notices and orders: July 29, 1907; May 29, June 16, November 12, 1908; March 3, March 27, June 2, 1909; March 12, April 4, June 6, June 25, July 2, September 10, 1910; March 7, March 24, April 21, December 30, 1911; March 13, March 14, March 19, May 23, June 24, September 5, 1912; February 5, March 11 (2), March 29, June 16, June 23, July 13, September 4, 1913; September 24, 1914; February 27, April 23, 1915; January 13, February 10, February 24, March 16, May 16, 1916.

Location of lands opened: Ts. 21 to 26 N., Rs. 51 to 65 W., sixth principal meridian.

Present status of irrigable lands opened: 69,031 acres entered subject to the reclamation act; 1,288 acres open to entry; 4,210 acres of State lands; 21,302 acres in private ownership; 17,837 acres of lands under the North Platte Canal & Colonization Co. tract in Wyoming.

Limit of area of farm units: Public, 80 acres; private, 160 acres.

Duty of water: Two and one-half acre-feet per acre per annum at the farm.

Charges per acre of irrigable land: Building, $45 and $55; annual operation and maintenance, $1 per acre, covering the use of not exceeding 1 acre-foot per acre, 25 cents per acre-foot for amounts between 1 and 2 acre-feet per acre, and 30 cents for each additional acre-foot.

CHRONOLOGICAL SUMMARY.

Reconnoissance made and preliminary surveys begun in 1902.
Construction recommended by director March 7, 1903.
Construction conditionally authorized by Secretary March 14, 1903.
First irrigation by Reclamation Service, season of 1908.
Whalen Diversion Dam completed February, 1909.
Pathfinder Dam completed June, 1909.
Pathfinder Dike completed May, 1911.
Interstate Canal, 165 miles completed June 30, 1914.
Pathfinder unit 99.1 per cent completed June 30, 1916.
Interstate unit 93.7 per cent completed June 30, 1916.
Fort Laramie unit 5.4 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the North Platte project provides for the storage of flood waters of North Platte River in a reservoir controlled by the Pathfinder Dam, about 3 miles below the junction of the North Platte and Sweetwater Rivers and 50 miles southwest of Casper, Wyo., and in smaller reservoirs along the canal lines; and the diversion of water from North Platte River by a dam near Whalen, Wyo., into the Interstate Canal, supplying water for lands on the north side of the river and into the Fort Laramie Canal, watering lands on the south side of the river. The United States claims all waste, seepage, spring, and percolating water arising within the project and proposes to use such water in connection therewith.

The completed features are: Pathfinder Dam and Dike; Whalen Diversion Dam; the first three divisions of the Interstate Canal; lateral systems of districts 1, 2, and 3 of the Interstate Canal system; Reservoir No. 1, known as Lake Alice; Reservoir No. 3, known as Lake Minatare. The Fort Laramie Canal system, covering approximately 100,000 acres, is now under construction.

SUMMARY OF GENERAL DATA FOR NORTH PLATTE (INTERSTATE) PROJECT TO JUNE 30, 1916.

Areas:	
Irrigable acreage when project is complete	129,891
Public land entered, June 30, 1916	81,310
Public land open to entry, June 30, 1916	1,288
Public land withdrawn, June 20, 1916	610
State land, June 30, 1916	5,338
Indian land June 30, 1916	
Private land, June 30, 1916	41,345
Acreage service could have supplied season of 1915	129,684
Acreage actually irrigated, season of 1915	[1] 78,057
Acreage cropped under irrigation, season of 1915	[1] 76,180
Crops:	
Value of irrigated crops, season of 1915	[2] $1,263,617.00
Value of irrigated crops per acre cropped	$18.55

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[1] Includes 8,050 acres of North Platte Canal & Colonization Co. lands.
[2] Does not include value of crops grown on N. P. C. & C. Co. lands.

Finances:

Estimated cost of completed project	$6,829,236.69
Total construction cost to June 30, 1916	$6,397,857.50
Per cent complete, June 30, 1916	93.7
Appropriation for fiscal year 1917, total	$251,000.00
Allotment for construction, fiscal year 1917	$122,000.00
Estimated per cent complete, June 30, 1917	95.5
Announced construction charges per acre	$55.00

Appropriation, fiscal year 1916			$340,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$171,178.54		
Transfers	15,872.12		
		$187,050.66	
Registered liabilities chargeable to 1916 appropriation		24,771.22	
			$211,821.88
Unencumbered balance, July 1, 1916			$128,178.12

Repayments:

Construction charges—	
Accrued to June 30, 1916	$417,388.00
Collected to June 30, 1916	$349,851.03
Uncollected, June 30, 1916	$67,536.97
Operation and maintenance charges (public notice)—	
Accrued to June 30, 1916	$364,172.33
Collected to June 30, 1916	$339,471.39
Uncollected, June 30, 1916	$24,700.94
Water rental charges—	
Accrued and uncollected to June 30, 1916	$392.00
Uncollected, June 30, 1916	$392.00

Drainage:

Miles of drains built to June 30, 1916—		
Open	17.5	
Closed	9.7	
		27.2
Estimated acreage protected by drains built to June 30, 1916		4,000
Estimated acreage to be protected by authorized system		5,000
Expended to June 30, 1916, on drainage works, completed and uncompleted		$153,235.20

FORT LARAMIE UNIT.

Areas:

Irrigable acreage when project is complete	100,000
Public land entered, June 20, 1916	25,695
Public land withdrawn, June 30, 1916	34,473
State land, June 30, 1916	7,176
Private land, June 30, 1916	32,656

Finances:

Estimated cost of completed project	$5,810,000.00
Total construction cost to June 30, 1916	$312,622.11
Per cent complete, June 30, 1916	5.4
Appropriation for fiscal year 1917, total	$1,390,000.00

Finances—Continued.

Allotment for construction, fiscal year 1917			$1,390,000.00
Estimated per cent complete, June 30, 1917			29.3
Appropriation, fiscal year 1916			$800,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$171,200.30		
Transfers	7,575.30		
		$178,775.60	
Registered liabilities chargeable to 1916 appropriation		95,186.42	
			$273,962.02
Unencumbered balance, July 1, 1916			$526,037.98

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

PATHFINDER SLUICING TUNNEL.

In order to provide for diverting the flow of the river during the construction of the Pathfinder Dam, the first work undertaken was the construction of a sluicing tunnel on the north side of the canyon around the site of the dam. The tunnel is driven through solid granite and has a length of 480 feet.

Plans for the sluicing tunnel were prepared in the fall of 1904, and were reviewed and approved by a board of engineers consisting of Messrs. A. P. Davis, A. J. Wiley, W. H. Sanders, and J. H. Quinton. Proposals for the construction of the tunnel were opened January 9, 1905, and a contract was executed January 21, 1905. The work was begun in February and completed in August, 1905.

In the winter of 1908–9 there was built by Government forces at the upper portal of the tunnel a grillage of concrete beams and columns supporting 1¼ by 6 inch steel bars; and in January, 1910, the construction by Government forces of a drainage tunnel from the upper gate shaft to the canyon wall below the dam was begun. This tunnel is 155 feet in length and has a section 5 feet square. It was completed in July, 1910.

PATHFINDER DAM.

The Pathfinder Dam is located in a deep narrow canyon on the North Platte River 3 miles below the mouth of the Sweetwater River and 50 miles from Casper, Wyo., the nearest railroad station. It is an arched masonry structure, the radius of the center line of the top being 150 feet. It has a maximum height of 218 feet, a maximum length of 432 feet, and a width at the top of 10 feet.

In March, 1905, a board of engineers consisting of Messrs. A. P. Davis, G. Y. Wisner, J. H. Quinton, A. J. Wiley, H. N. Savage, C. E. Wells, and D. C. Henny approved plans and specifications for the dam. Proposals were opened in Denver June 15, 1905, and a contract was awarded, but the bidder failed to qualify. The work was readvertised and proposals were opened August 16, 1905. A contract for construction was executed on September 1, 1905, and work was begun on September 25, 1905, and finished on June 14, 1909.

HIGH-PRESSURE GATES.

At the bottom of the upper shaft an enlargement of the sluicing tunnel contains the gate chamber where are installed the four gates which control the discharge of the tunnel.

Designs for the gates, operating mechanism, gate chamber, and power house were prepared in 1906 and reviewed on July 16 and 17, 1906, by a board of engineers, consisting of Messrs. O. H. Ensign, A. J. Wiley, H. N. Savage, W. H. Sanders, and L. C. Hill. After certain changes proposed by the reviewing board had been made, the designs, plans, and specifications were prepared, and were approved by the department on October 26, 1906. Proposals for supplying and installing the gates and operating mechanism were opened on December 20, 1906, and a contract was executed February 14, 1907. The contractor was required to erect the gate frames and install the gates and operating mechanism, but the excavation required for the placing of the necessary concrete, and the construction of the gate house were done by the Unietd States. The manufacture of the gates was begun by the contractor soon after the execution of the contract, and the delivery at the project of the gates, gate frames, and operating mechanism was made in January and February, 1908. The installation of the gates was begun in February and completed in April, 1908. The power house over the gate shaft was constructed by Government forces in the winter of 1908–9, and the operating machinery for the gates was installed during April and May, 1909.

PATHFINDER DIKE.

The Pathfinder Dike is located at a gap in the rim of the reservoir one-quarter of a mile south of the Pahtfinder Dam. The elevation of the lowest point of the gap is 5,832, or 20 feet below the elevation of the spillway of the dam. The dike is an earth embankment 1,650 feet long and 20 feet wide on top, with a slope of 3 to 1 on the water face and 2 to 1 on the lower face, and a maximum height of 38 feet. Twenty-five feet upstream from the center line is a concrete core wall which reaches within 12 feet of the top of the dike or 6 feet above the crest of the spillway.

Proposals for the construction of the dike were opened February 27, 1907, but all bids were rejected because they were considered excessive. The work was readvertised and proposals requested for June 5, 1907, but no proposals were received. A small embankment on the site of the dike was built by Government forces in July, 1909, and proposals for the completion of the dike were opened on October 28, 1909. The bids received were considered excessive and were rejected, and on December 22, 1909, the Secretary of the Interior authorized the construction of the dike by Government forces. Work was begun on March 4, 1910, and the embankment proper was completed on September 25, 1910. Work on the paving was continued until December 23, 1910, when it was suspended for the winter. Work was again resumed on March 30, 1911, and the dike was completed on May 8, 1911.

SOUTH SIDE OUTLET TUNNEL.

On December 12, 1909, a board of engineers, consisting of Messrs. D. C. Henny, W. H. Saunders, O. H. Ensign, R. F. Walter, and E. H. Baldwin, recommended the construction of an additional outlet tunnel around the south end of the dam. Plans for this tunnel were reviewed and approved by a board of engineers on January 24, 1910. These plans provided for a lined tunnel section 14 feet wide and 15 feet high. Its length is 360 feet and the elevation of the tunnel floor at its upper end is 5,726 feet. Its slope is 1 in 100. As subsequently built, the floor and a portion of the outer curve side wall were lined with concrete and the section was enlarged to approximately 20 feet in width. Construction was commenced by Government forces on February 7, 1910. This tunnel was driven through solid granite; it was driven from both portals, the upper half being carried through as a heading during the winter of 1909–10 as an emergency section. The lower part was excavated during the following year.

The discharge from this tunnel is controlled by six 58-inch diameter balanced needle valves, discharging directly into 60-inch diameter steel-lined cast-iron pipes from 18 to 45 feet in length, connecting these valves with the south tunnel. These valves consist essentially of a cylindrical piston moving in a bronze-lined cylindrical chamber with a clearance of 0.005 inch. The valves are operated by adjusting the water pressure in the chamber back of the piston by means of 4-inch control valves, which are placed at the downstream canyon face and are connected with these piston chambers by means of 4-inch pipes, called control pipes. Closing any of these control valves accumulates the pressure in the chamber back of the piston and causes the piston to move forward to its seat, thereby closing the discharge. In order to overcome unexpected frictional resistances provision was made later for an increase of this pressure by means of a 4-inch turbine-driven two-stage centrifugal pump. In opening these valves the process is reversed by opening these control valves and allowing the water to escape from the chamber back of the piston, thereby releasing the holding pressure and permitting the backward motion of the piston, which is induced by the water pressure from the reservoir. These control pipes were at first placed in the concrete floor of the main tunnel, but, owing to difficulties which developed during the season of 1912, they were later placed in a small tunnel, called the auxiliary tunnel, 6 by 6 feet cross section and 209 feet in length, located between the south tunnel and the south abutment of the dam. At the reservoir end this tunnel connects with the grillage chamber surrounding the balanced valves and the downstream end pierces the canyon wall 45 feet below the dam, with its floor at elevation of about 5,710, or about 45 feet above the original river bed.

The valves are arranged in two horizontal tiers and are surrounded by a reinforced concrete grillage consisting of three vertical chambers, each supporting 1 inch by 5 inch steel grillage bars on the top and reservoir faces. The grillage area is 1,550 square feet, permitting a flow of 4.4 feet per second with maximum valve opening and assuming a wholly unobstructed condition. The cast-iron tubes leading the valve discharges into the tunnel are embeded in a mass of concrete filling the reservoir end of this tunnel for a minimum length of about 20 feet. This mass or concrete plug serves also as an anchorage for the balanced valves. The placing of this concrete plug was begun February 8, 1911, and completed December 7, 1911, work being suspended during the period March 18 to September 20, owing to the rise of the water in the reservoir. The valves were installed during the winter 1911–12 following the completion of the grillage chamber. The placing of the valves was completed in February, 1912.

During the summer of 1912 the location of control pipes in the concrete of the south tunnel floor proved unsatisfactory, and it was then decided to build the auxiliary tunnel, above referred to, and place these pipes in this tunnel to insure further safety of operation.

On November 18, 1912, a board of engineers met to consider certain defects in the operation of the balanced valves and the discharge control and it was decided to make certain changes in these valves and to extend the concrete plug into the tunnel an additional length of 25 feet. It was also later decided to widen the lower 100 feet of the tunnel to an average width of 20 feet and to drive a cross-cut tunnel from the auxiliary tunnel to the roof of the south tunnel, 10 feet below the end of the discharge pipe to provide free admission of air. This work was undertaken in December, 1912, and completed on April 10, 1913. The cross-cut tunnel above noted is about 4 by 5 feet in section and 55 feet long. Air drills were used in this work.

A board of engineers, consisting of Messrs. D. C. Henny, O. H. Ensign, and R. F. Walter, convened on December 17, 1914, and considered the defects which had developed in the erosion of the extension plug of the south tunnel and the deterioration of the 5-foot cast-iron pipes. This resulted in the removal of the remaining portions of the plug extension in the extension of the air conduct to the discharge end of these pipes and the insertion of steel linings in the cast-iron pipes. These linings consist of one-half inch steel pipes of varying diameter, ranging from a minimum of 52 inches at a distance of 13½ inches from the intake to a maximum of 54 inches at the outlet end and joining the intake by steel casting of curved section to conform approximately to the curve of the jet. These linings were anchored in place by grouting. It was also decided to line the right or outer curved side of the tunnel for a distance of 140 feet below the end of these pipes. This work was begun about February 1, 1915, and completed May 3, 1915.

WHALEN DIVERSION DAM.

The Whalen Diversion Dam is located on North Platte River near Whalen, Wyo., more than 150 miles below the Pathfinder Reservoir, and diverts water into the Interstate and Fort Laramie Canals. The dam is a concrete weir, 300 feet long, with a maximum height of 29 feet, resting on a conglomerate foundation. At each end of the dam are two sluice gates each 5 feet 9 inches wide and 6 feet high. Beyond the sluice gates and at right angles to the dam are located at the north end the headworks for the Interstate Canal, and at the south end the headworks of the Fort Laramie Canal. Beyond the headworks of the Fort Laramie Canal is an earth dike extending 2,000 feet to high ground, with a maximum height of 25 feet and slopes of 2½ to 1.

Plans for the construction of the diversion dam and headworks were reviewed and approved by a board of engineers consisting of Messrs. A. P. Davis, W. H. Sanders, C. E. Wells, and John E. Field, and proposals for the work were opened November 1, 1906. There was but one bidder, no award was made, and the work was readvertised. Proposals were opened on January 9, 1907, and a contract was executed and the work begun during February, 1907. The progress of the work was unsatisfactory, and after the dam and the headworks of the interstate canal had been nearly completed, the contract was suspended on August 18, 1908, and the work was completed by Government forces in February, 1909.

INTERSTATE CANAL.

The Interstate Canal heads at the Whalen Diversion Dam on North Platte River and for the first part of its course follows the line of the Whalen Falls Canal.

Division 1 of the canal is 45 miles long and extends from the headworks nearly to the Wyoming-Nebraska State line. The canal is designed for a capacity of 1,400 second-feet at the headworks and 1,200 second-feet at the end of the first division. The bottom width at the headworks is 34 feet and its depth is 13 feet throughout with a water depth of 10 feet.

Division 2 of the canal extends from the forty-fifth to the ninety-fifth mile at reservoir site No. 1. It is designed for a capacity ranging from 1,200 second-feet at the upper end to 743 second-feet at the lower end; its bottom width is 28 feet at the upper end and 22 feet at the lower end.

Division 3 of the canal extends below the end of the Interstate Canal proper and consists of three canals. The Reservoir Supply Canal extends from Lake Alice to Lake Minatare, a length of 5 miles. Its capacity is 492 second-feet and its bottom width 22 feet. The High Line Canal is an extension of the Interstate Canal proper, and extends from where the latter empties into Lake Alice to a point in sec. 36, T. 22 N., R. 52 W., with a length of 37 miles, and a capacity at the head of 160 second-feet. The Low Line Canal extends from the outlet of Lake Minatare to a point in sec. 24, T. 21 N., R. 51 W., with a length of 42 miles and a capacity at the head of 343 second-feet.

Plans for excavation of the first division of the Interstate Canal were reviewed and approved by a board of engineers consisting of Messrs. A. P. Davis, J. H. Quinton, and H. N. Savage, and proposals for construction were opened May 16, 1905. The work involved the excavation of about 3,000,000 cubic yards of material, and five contracts were executed for different parts of the work. The work was begun in July, 1905, and completed in June, 1906.

Proposals for building structures on the first division of the Interstate Canal were opened November 8, 1905; contract was executed November 23, 1905; and the work was begun January 3, 1906, and completed in July, 1907. The work involved the excavation of nearly 50,000 cubic yards of earth and the placing of about 12,000 cubic yards of concrete.

Proposals for excavation of the second division of the Interstate Canal were opened on November 8, 1905. Three contracts were executed, involving in all the excavation of about 3,000,000 cubic yards of material. The work was begun in March, 1906, and completed in July, 1907.

Proposals for building structures for the second division of the canal were opened June 26, 1907. Contracts were executed and the work was begun July 25, 1907, and completed May 18, 1908.

The excavation for the third division of the canal was let in numerous small informal contracts, bids being opened on several dates, beginning November 13, 1909, and ending September 19, 1914. The work was completed on April 18, 1915.

The construction of the structures on the third division of the canal was undertaken by Government forces, the work beginning in the spring of 1910 and being carried to completion in the spring of 1915.

DISTRIBUTING SYSTEM.

The distributing system under the Interstate Canal consists of three districts. The first district embraces the lateral system serving lands west of Dry Spottedtail Creek. The second district embraces the lateral system, serving land east of Dry Spottedtail Creek and west of Winters Creek. The third district embraces the lateral systems serving lands east of Winters Creek under the third division of the canal. The water supply for this district is taken partly directly from the Interstate Canal and partly from Lake Alice and Lake Minatare. The entire lateral system is now completed.

Proposals for excavating the laterals of the first district were opened June 15, 1906. Twelve contracts were executed for different parts of the work. The work was begun in the summer of 1906 and completed in the spring of 1907. The structures in this district were built by Government forces and were completed in the spring of 1908.

Proposals for excavating the laterals of the second district were opened May 21, 1907, and four contracts were executed. The work was begun in June and completed in December, 1907, and involved the excavation of about 700,000 cubic yards of material. The lateral structures for the district were built by Government forces and consist of about 300 concrete drops, flumes, wasteways, and other structures, and numerous wooden structures. Work on the structures was begun in June, 1908, and completed in the spring of 1909.

Excavation of the laterals of the third district was done by small informal contracts from late in 1909 to its completion early in 1915. The structures in this district were constructed by Government forces during the same period and consisted of the usual type of concrete drops, flumes, turnouts, and wasteways, and numerous wooden bridges and farmers' head gates, also a long combination concrete and wood stave pipe siphon.

SUPPLEMENTAL STORAGE.

For the irrigation of the third lateral district supplemental reservoirs are necessary. Four sites were available—Nos. 1, 2, and 3, and Winters Creek Lake. Reservoir No. 1, known as Lake Alice, and No. 3, known as Lake Minatare, have been constructed.

LAKE ALICE RESERVOIR.

Lake Alice lies at the end of the Interstate Canal in secs. 5, 6, 7, and 8, T. 23 N., R. 54 W. It is formed by Dam No. 1 at the southwest end of the lake and Dam No. 1½ at the east end and has a capacity of 11,400 acre-feet. Dam No. 1½ is an earth fill with 3 to 1 slopes on both faces, a top width of 20 feet, a top elevation of 4,192 feet, a total length of 2,547 feet, and a maximum fill of 23 feet. The upstream face is paved with rock 12 inches thick on a foundation of spalls 14 inches in depth. The concrete outlet is near the middle of the dam, with a floor elevation of 4,159 feet, and discharges through a semicircular barrel with a 6-foot radius. The discharge is controlled by two vertical rectangular sliding gates. The outlet structure was built by Government forces in the spring of 1911. The excavation for the embankment was done partly by Government forces, but mostly by contract, in 1911. The compacting of the embankment was done by Government forces. The total excavation was 103,490 cubic yards. The paving of the upstream face was done by Government forces in 1911 and 1912.

Dam. No. 1 is an earth fill, the lower one-fifth being of brule clay; the slope of the upper face is 3 to 1 and of the lower face 2½ to 1; the top width is 20 feet, the top elevation 4,192 feet, the total length 3,103 feet, and the maximum fill 30 feet. A drain of 8-inch tile laid in gravel 5 feet below ground surface was built under the lower part of the dam. Under the upper part of the dam a cut-off trench was dug from 3 to 7 feet into the brule clay. The upper slope is faced with 12 inches of paving underlaid by 18 inches of gravel and spalls. The concrete outlet structure discharging into lateral 24 near the east end of the dam has three conduits, each 3 feet by 4 feet with a floor elevation of 4,168 feet, closed by rectangular sliding gates. The outlet structures, drain, and cut-off trenches were built by Government forces between May, 1911, and May, 1912. The building of the embankment was done by contract in the summer of 1912 and amounted to 214,234 cubic yards, including the spillway excavation, which was used in the embankment. The compacting of the embankment was done by Government forces in the fall of 1912. A spillway 100 feet long with a crest elevation of 4,182 was constructed immediately north of Dam No. 1.

LAKE MINATARE RESERVOIR.

Lake Minatare lies in the southwest corner of T. 23 N., R. 53 W., has a capacity of 67,000 acre-feet, and is formed by Dam. No 3, which is located about 400 feet north of the south line of section 32, its center line running east and west. The dam is an earth and gravel fill, the lower part being of gravel; its length is 3,700 feet, top width 20 feet, top elevation 4,140 feet, maximum fill 63 feet; both faces have a slope of 2½ to 1, except the top 15 feet of the upper face which has a slope of 2 to 1. The upper face is paved with concrete slabs 8 inches thick, 10 feet wide, and 20 feet long, underlaid with 12 inches of unscreened gravel. Upstream from the center line is a cut-off trench extending into brule clay from 6 to 34 feet. In this cut-off trench was built a reinforced concrete core wall from 1 to 2 feet in thickness, with its top at about the ground surface. Under the gravel portion of the fill was constructed a drain of 12-inch tile surrounded by gravel in a trench about 5 feet deep. A spillway, with a minimum width of 100 feet and a crest elevation of 4,125 feet, was constructed around the west end of the dam and immediately adjoining it. The outlet conduit is located just east of the low point of the valley and is built wholly in brule clay. It consists of a reinforced-concrete barrel 12 feet 10 inches in horizontal diameter and 11 feet in vertical diameter, which carries two lines of 48-inch steel lock-bar pipe. Each line of pipe is closed at the upper end by a 48-inch flutter valve for emergency purposes, and at the lower end by two 24-inch needle valves which control the discharge.

Proposals for the construction of Dam No. 3, under Specifications No. 203, were opened in Mitchell, Nebr., on February 28, 1912, and all bids were rejected as being unsatisfactory. The work was readvertised under a reissue of Specifications No. 203, and proposals were opened on April 22, 1912. Contract No. 499, for construction, was executed May 24, 1912. Work was begun on June 29, 1912, and completed on June 21, 1915.

The contractor's plant consisted principally of a clam-shell excavator; traction engines; elevating graders; 12-yard and 2-yard dump wagons; drag-line buckets, with cables; hoist engines; a crushing, screening, and mixing plant; pumps; and boilers.

All the earth and gravel taken from the trenches and spillway was placed in the embankment; most of the brule clay was wasted or placed at the downstream toe of the dam. The greater part of the material for the embankment was taken from pits at both ends of the dam.

The construction of the dam involved the handling of 864,322 cubic yards of earth and gravel fill, 15,176 cubic yards of unscreened gravel, 27,209 cubic yards of brule-clay excavation, and 17,286 cubic yards of concrete.

Water was first stored in the lake in the fall of 1914, and in November of that year seepage developed, starting about 300 feet below the toe of the dam. For the purpose of reducing this seepage, wells were drilled in a line parallel to the axis of the dam just above the core wall to depths of 100 to 125 feet and grout was forced in under a pressure of 100 pounds per square inch. The results proved satisfactory. This work was done by Government forces in the summer of 1915.

Various phases of the design and construction of the dam were considered by the following boards of engineers, and reports made on the dates named: A board consisting of Messrs. A. P. Davis, D. C. Henny, R. F. Walter, Andrew Weiss, and O. T. Reedy, opened proposals and recommended changes in specifications on May 2, 1912. On June 8, 1913, a board consisting of Messrs. A. P. Davis, D. C. Henny, R. F. Walter, and Andrew Weiss considered conditions in the cut-off trench and made report thereon. On December 8, 1914, and again on January 26, 1915, a board consisting of Messrs. D. C. Henny, R. F. Walter, and Andrew Weiss, considered the seepage under the dam and made reports thereon.

SEEPAGE AND DRAINAGE.

Seepage began to appear on the North Platte project in the fall of 1909 in the lower parts of the valleys adjacent to the land which had been irrigated during that and the preceding season. It developed most notably in the Lower Sheep Creek bottom and gradually spread here, as well as in the other valleys, reaching apparently a maximum development in the season of 1911, following an unusually heavy application of water. On May 2, 1912, a board of engineers, consisting of Messrs. A. P. Davis, D. C. Henny, R. F. Walter, and Andrew Weiss, recommended that investigations be made and plans prepared for the drainage of seeped areas.

In accordance with this board's recommendation and under the direction of Mr. D. W. Murphy, engineer in charge of drainage, investigations were started and a drag-line excavator and a trench machine were purchased, as it was thought impracticable to let this kind of work by contract. Work was started in the second lateral district in September, 1912. During the remainder of that season the Sunflower drain, a 12-inch tile drain, was started, and the Hiersche drain, which is an open cut, was begun with the drag-line excavator.

This drainage work was again resumed in April, 1913, and continued throughout that season. In that season the Banner drain was first built. It consists of 4,200 linear feet of open drain and 5,950 linear feet of 12-inch tile line. Following this the McAllister drain was put under way; this is a tile drain of a total length of 13,814 feet, of which 9,934 feet are 15-inch, 2,760 feet 12-inch, and 1,120 feet 10-inch diameter.

The drag-line excavator continued excavating the Hiersche drain during the season of 1913, completing the main line that fall. This is an open drain 22,400 feet in length and extending from a point near the southwest corner of sec. 23, T. 23 N., R. 55 W., in a northeasterly direction to Dam No. 1, Lake Alice. The principal object of this drain is to take care of the seepage resulting from Lake Alice, as well as some marginal seeped areas which have developed along its course.

In the summer of 1913 the Dunham drain was started; this is for the most part a covered tile drain. In its completed state it consists of 4,050 feet of open drain and 24,026 feet of tile drain, of which 6,440 feet are 15-inch diameter and 17,586 feet 12-inch. The building of the Dunham drain was carried through the remainder of the season of 1913 and practically completed in the season of 1914, excepting a few additional spurs which were added in the season of 1915.

Upon the beginning of storage in Lake Minatare, seepage immediately began to appear, mostly in the form of springs some 400 feet below the toe of the dam to the extent of several second-feet. This occurred in November, 1914, and in order to save considerable good agricultural land below, an open drain was started to connect this locality with the Nine Mile draw in sec. 28, T. 22 N., R. 53 W. This is known as the Alliance drain, the total length of which is 31,400 feet. This drain was completed in the season of 1915; the excavation was done by means of the trench machine and partly by team and hand labor.

The Sunflower drain was partly relocated and completed in the spring of 1914. This is a 12-inch tile drain 6,900 feet in length.

Following the completion of the Sunflower drain, the Stewart drain was begun in 1914 and completed in the following year. This is an open drain with branches designed to reclaim a body of seeped land in the so-called Stewart draw, adjacent to and west of Dry Spottedtail Creek.

CONSTRUCTION DURING FISCAL YEAR.

Pathfinder Reservoir.—Repairs were made to the steel lining of the discharge pipes in the south tunnel. Repairs were also made to the floor and side walls in the Pathfinder Tunnel just below the gate passages.

Interstate Canal.—The only construction consisted of minor lateral extensions on various parts of the project.

DRAINAGE.

Surveys and investigations incident to design, location, and construction of drainage works were continued during the year. These investigations include borings over the affected areas and areas likely to become seeped to determine the subsoil conditions, the elevation and periodic variation of the water table and other factors bearing upon the location and construction of the drainage works. Information was obtained from the water users as to strata penetrated by their wells and original and present water level in the wells.

During the year a short branch of the Dunham drain was built, consisting of 526 linear feet of 12-inch tile. Three branches of the Stewart drain, with an aggregate length of 4,924 linear feet of open drain were built, involving wet excavation amounting to 25,492 cubic yards. Many open wells were also put down in the bottom of the drain to the underlying water-bearing stratum of gravel.

The upper part of the McAllister drain was rebuilt on a new location. The new line, with branches, is 9,700 feet long, of which 5,820 linear feet are 15-inch tile, 2,760 feet 12-inch tile, and 1,120 feet 10-inch tile. The total length of this drain is now 13,900 feet.

Late in the season of 1915 the Sheep Creek drain was started by means of the trench machine. The work accomplished during that season was an open drain through the Sand Hills, emptying in the SE. ¼ sec. 22, T. 24 N., R. 58 W., and extending in a generally northerly direction to approximately the southeast corner of sec. 36, T. 25 N., R. 57 W., a distance of about 4 miles. This drain relieved the accumulation of a large body of seepage water in the so-called Sheep Creek sinks, and also resulted in the lowering of the ground water in the upper Sheep Creek Basin.

With the beginning of the season of 1916 the drag-line excavator was moved to upper Sheep Creek, because it was found necessary to deepen and enlarge this drain from the lower portion of Sheep Creek sinks northerly in order to furnish a suitable outlet for the drainage works in the upper portion of the Sheep Creek area. This work is at present under way.

The drainage work has developed many unexpected difficulties, especially in the matter of closed drains.

ECONOMIES OF GOVERNMENT WORK.

The North Platte project has not had occasion to construct or operate industrial plants, and while a large amount of work has been done by Government forces, little of such work has been advertised, and almost no similar work has been done by contract under similar circumstances, so that in most cases no exact comparison of cost can be made.

On the basis of the lowest bid received on October 28, 1909, the estimated cost of the Pathfinder Dike by contract was $255,881.18, while the actual cost by Government forces was $221,799.77, showing a saving of $34,081.41. It is found that as a general rule structural work is accomplished better and more cheaply by Government forces, especially the smaller types on the distributing system, which are usually widely scattered and which need frequent modifications of plan to suit local conditions.

OPERATION AND MAINTENANCE.

The system as operated during the present season consisted of the Pathfinder Reservoir, the Whalen Diversion Dam, 95 miles of main canal; Lake Alice, 5 miles of Reservoir Supply Canal; Lake Minatare, 37 miles of High Line Canal, 42 miles of Low Line Canal, and 670 miles of laterals.

In 1915 water to the amount of 96,467 acre-feet was delivered to 1,095 farms, containing approximately 70,007 acres in crop, exclusive of the lands of the North Platte Canal & Colonization Co., to which 26,261 acre-feet of water were delivered for the irrigation of 88 farms, containing approximately 8,050 acres in crop. The average amount of water used upon the land under the interstate unit was 1.38 acre-feet per acre, and upon the land of the North Platte Canal & Colonization Co., 3.27 acre-feet per acre. The total diversion at the Whalen Dam during the irrigation season of 1915 was 294,188 acre-feet. The unusually small amount of water used was due to the large rainfall during the summer.

During the first part of the season of 1916, 86,441 acres were entitled to water under water-right application, 8,420 acres under rental contracts, and 17,837 acres under contract with the North Platte Canal & Colonization Co. Of this amount approximately 80,564 acres were under cultivation under the different arrangements. Water was diverted into the Interstate Canal on April 26, 1916; the maximum diversion to June 30 was 1,435 second-feet. The prevalence of showers and and the cool weather have rendered the use of water light for the first part of the season of 1916, and water was delivered on demand up to June 27, after which it was delivered on rotation. The storage in Pathfinder Reservoir was 668,580 acre-feet on July 1, 1915, decreasing to 273,400 acre-feet on September 26, 1915, increasing to 814,010 acre-feet on June 25, 1916, and again decreasing to 799,370 acre-feet on June 30, 1916.

Historical review, North Platte project.

Item.	1911	1912	1913	1914	1915	1916
Acreage for which service was prepared to supply water....	[1] 96,898	[1] 103,837	[1] 109,272	[1] 109,341	[1] 129,684	[1] 129,891
Acreage irrigated..............	[1] 49,411	[1] 55,631	[1] 63,366	[1] 67,700	[1] 78,057	[1] 80,564
Miles of canal operated........	534	602	648	652	848	848
Water delivered to land (acre-feet).......................	[2] 190,427	[2] 113,251	[2] 141,489	[2] 176,915	[2] 96,467	....
Per acre of land irrigated (acre-feet).......................	[2] 4.26	[2] 2.25	[2] 2.49	[2] 2.92	[2] 1.38	....

[1] Includes North Platte Canal & Colonization Co. lands.
[2] Exclusive of lands under North Platte Canal & Colonization Co. tract.

SETTLEMENT.

Conditions on the project continued to improve throughout the year, due to good crops, good markets, and the lessened payments under the extension act. The number of land transfers has been about normal. The remainder of the vacant land in the third lateral district has been opened for settlement. There are now 20 farm units on the project open to entry. Good profits have been made by feeding stock. Hog cholera no longer exists on the project. The following table shows settlement data for the years 1912 to 1916, inclusive, for the lands under the Interstate Canal irrigated by the Reclamation Service:

Settlement data, North Platte project.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	1,270	1,270	[1] 1,270	[1] 1,456	[1] 1,467
Population	2,504	2,774	[1] 3,800	[1] 4,000	[1] 4,200
Number of irrigated farms	777	908	944	1,095	[1] 1,200
Operated by owners or managers	575	603	567	682	760
Operated by tenants	202	305	377	413	440
Population	(2)	(2)	3,290	3,828	[1] 4,000
Number of towns	7	7	7	7	7
Population	4,600	4,762	[1] 4,900	[1] 5,000	[1] 5,500
Total population in towns and on farms	7,104	7,536	[1] 8,700	[1] 9,000	[1] 9,700
Number of public schools	24	30	34	34	34
Number of churches	25	25	25	25	25
Number of banks	13	13	14	15	16
Total capital stock	$277,000	$277,000	$302,000	$317,000	$352,000
Total amount of deposits	(2)	$1,160,000	$1,704,000	$1,710,000	$1,800,000
Total number of depositors	....	....	....	[1] 5,700	[1] 6,000
Number of relinquishments	5	10	1	1	....
Number of cancellations	14	8	6	....	....

[1] Estimated.

[2] Data not available.

PRINCIPAL CROPS.

The cropped area has continued to increase, until in 1916 it is estimated to amount to 80,564 acres, including the North Platte Canal & Colonization Co. lands. Of this amount about 47 per cent is in alfalfa, 34 per cent in cereals and corn, 11 per cent in sugar beets, and the remaining 8 per cent in potatoes and miscellaneous crops. The total value of the crops on the Interstate unit for the year 1915 was $1,263,617, with an average value of $18.55 per acre, as compared with a total value of $890,202 and an average value of $14.95 per acre for 1914. Increased returns were most pronounced in the case of sugar beets, potatoes, and corn. Low temperatures and severe hailstorms have retarded the growth of crops in 1916, but the indications are that crops will be good.

The following tabulated crop report for 1915 is for the Interstate unit only:

Crop report, North Platte project (Interstate), year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa hay	31,788	Tons	62,491	2.0	$5.00	$312,455	$9.83
Alfalfa seed	134	Bushels	121	.9	8.00	968	7.22
Barley	2,329	...do	87,037	37.0	.45	39,167	16.82
Beans	96	...do	987	10.3	3.90	3,849	40.09
Beets, sugar	7,872	Tons	97,753	12.5	5.50	537,641	68.30
Beets, stock	276	...do	4,498	16.3	3.00	13,494	48.88
Cane fodder	63	...do	130	.8	2.00	260	1.60
Corn fodder	103	...do	394	3.8	1.00	394	3.82
Corn, Indian	10,343	Bushels	209,626	20.0	.50	104,813	10.13
Millet hay	113	Tons	153	1.4	5.00	765	6.76
Garden	219					4,071	18.58
Hay, native	181	Tons	137	.7	8.00	1,096	6.06
Millet seed	106	Bushels	1,444	13.6	1.00	1,444	13.62
Oats	7,112	...do	198,692	28.0	.40	79,477	11.18
Onions	6	...do	990	165.0	1.00	990	165.00
Pasture	3,064				8.00	24,512	8.00
Potatoes	1,395	Bushels	251,833	181.0	.40	100,733	72.21
Rye	168	...do	1,551	9.0	.50	775	4.62
Spelt	81	...do	1,729	21.0	.40	692	8.54
Wheat	1,878	...do	33,785	18.0	.90	30,407	16.19
Miscellaneous	803					5,614	6.99
Total cropped acreage.	68,130	Total and average				1,263,617	18.55

		Areas.	Acres.	Farms.	Per cent of project.[1]
Irrigated, no crops:					
Alfalfa seeded with nurse crop	4,809	Total irrigable area farms reported	87,554	1,095	79
		Total irrigated area farms reported	70,007	1,095	63
Alfalfa seeded; no nurse crop	1,877	Under water-right applications.	66,542	1,024	60
Less duplicated areas	4,809	Under rental contracts L. L. lands 3170–66; State lands 295–5.	3,465	71	3
Total irrigated acreage	70,007	Total cropped area farms reported	68,130	1,095	61

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[1] Interstate unit based on total of 111,414 acres. (Public-notice lands, 93,295 acres. Water-rental lands, 18,119 acres.)

SALE OF SUPPLEMENTAL STORAGE RIGHTS FROM PATHFINDER RESERVOIR TO PRIVATE LANDS.

In accordance with the plans outlined in previous annual reports, contracts for the sale of supplemental storage water to the Pleasant Valley Lateral Association and the Goshen Land Co. have been approved by the Secretary of the Interior.

The hydraulic studies mentioned in the thirteenth and fourteenth annual reports are being continued by a competent hydrographer, and in cooperation with the State of Nebraska, for the purpose of determining losses in transmission and accessions from tributaries and obtaining such other information as will aid in a determination of water rights and proper water distribution.

FORT LARAMIE UNIT.

GENERAL.

The lands to be irrigated by the Fort Laramie unit lie on the south side of the North Platte River, partly in Wyoming and partly in Nebraska. The main canal which is to serve this unit is known as the Fort Laramie Canal, and as noted under the project heading, "Irrigation plan," water for this canal is diverted from the North Platte River by the Whalen Dam, which also diverts into the Interstate Canal, supplying water for lands on the north side of the river.

The canal will be about 127 miles long, extending to a divide between Gering and Creighton Valleys. The area to be covered comprises about 100,000 acres, approximately 45,000 of which are in Nebraska and 55,000 in Wyoming. Of this area the principal portion is in what is known as Goshen Hole or Goshen Park.

SURVEYS.

The earliest surveys to be made in connection with the investigation of the lands in this unit were begun in 1903 and continued during portions of the two following years, after which this work was discontinued for several years and attention given principally to survey and development of the Interstate unit.

Surveys were again begun in 1910 and continued during portions of 1911 and 1912. The survey upon which were based the estimates resulting in the approval of the construction of this unit was that in 1912 in charge of H. W. Bashore, assistant engineer, and the present location is being made practically as it was then surveyed.

This survey keeps fairly close to the river to a point above the junction of Cherry Creek with the river, distant about 36 miles from the headworks, making a small detour up the Laramie River and another larger detour to take in the level valley known as London Flats. The canal then continues up the Cherry Creek Valley and crosses the divide between Cherry Creek and Horse Creek; continuing through Kiowa and Owl Creek Valleys, passing into the Gering Valley through a tunnel under the ridge west of Gering.

At a board meeting held in Mitchell, Nebr., May 4, 1912, convened for the purpose of considering a report of the survey above mentioned, it was recommended that the construction of the Fort Laramie unit be undertaken, provided that 95 per cent of the deeded land should be pledged for its proportionate cost of its part of the construction.

Attempts were made to secure these pledges during the next two or three years, and in October, 1914, the Secretary of the Interior reduced the requirements to 90 per cent.

On June 7, 1915, report was made to the director and chief engineer to the effect that 90 per cent of the irrigable area in private ownership was then subscribed, and shortly thereafter direction was given that final location surveys be made for the purpose of early advertisement of earthwork and the beginning of construction.

The first advertisement was made on August 7, 1915, and covered about 10 miles of canal earthwork. This is known as the first division of the canal.

Surveys were continued, completing the second division, amounting to about 5½ miles, and advertisement of this division was made on February 8, 1916.

The third division consists of about 8½ miles and was advertised on April 20, 1916.

Surveys covering the final location, including cross section of the fourth division amounting to about 19 miles, have been completed and advertisement is now being prepared covering this work; the total completed final surveys amount to about 43 miles. Of this amount, 24 miles are either under construction or under contract for construction.

CONSTRUCTION DURING FISCAL YEAR.

Bids for the first division of earthwork were opened on September 8, 1916, and contract for schedules 1 and 2 awarded to Winston Bros. Co., of Minneapolis, and schedules 3 and 4 awarded to the Fred M. Crane Co., of Omaha. This work began early in October and continued through the winter. Winston Bros. Co. contract was completed in May, 1916, and the Fred M. Crane Co. contract, schedules 3 and 4, is about 97 per cent completed.

On March 10, 1916, bids were opened on the second division earthwork, comprising about 5½ miles. At the same time bids were opened for two reinforced concrete siphons, one under Laramie River, about 270 feet long and one under Deer Creek, about 150 feet long, as well as three large reinforced concrete culverts for taking care of cross-country drainage.

MacArthur Bros. Co., of New York City, were awarded contract for the earthware and the culverts, and the Security Bridge Co., of Minneapolis, were awarded the contract for the siphons.

Work was commenced on the Laramie siphon late in April and so far has consisted in the driving of sheet piling to form one section of cofferdam, together with a small amount of excavation.

Work on excavation for the three culverts was begun in May.

The earthwork contractors shipped, and began the erection of, a drag-line excavator early in May and also sublet a considerable portion of their work to team outfits.

On April 18, 1916, advertisement was made covering two tunnels; one in the sixth mile and one in the sixteenth mile of the canal. Bids were opened on May 22 and contract for this work was awarded to MacArthur Bros. Co., of New York City. The actual construction work on the tunnels has not begun.

On May 25, 1916, bids were opened for the third division of earthwork. Contracts were awarded to MacArthur Bros. Co., New York City, schedule 1; Winston Bros. Co., of Minneapolis, schedule 2; J. E. Hilton, Billings, Mont., schedules 3 and 4.

Work has not begun on any part of division 3, but contractors are engaged in getting their equipment on the ground.

PRINCIPAL BOARD MEETINGS.

May 4, 1912. Personnel: A. P. Davis, D. C. Henny, R. F. Walter, and Andrew Weiss. This board examined report of investigations and surveys, together with estimate of cost, covering proposed construction of Fort Laramie unit, compiled by H. W. Bashore, assistant engineer, under the direction of the project manager.

July 12, 1915. Personnel: D. C. Henny, Andrew Weiss, and O. T. Reedy. This board met in Mitchell, Nebr., and drafted a report addressed to the chief of construction covering designs and specifications for the Fort Laramie unit.

December 20, 1915. Personnel: E. H. Baldwin, E. A. Moritz, and O. T. Reedy. This board met in Denver, Colo., and made a report to the chief of construction in regard to tunnel work and open canal construction.

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, JANUARY 13, 1916.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water will be furnished under the North Platte project, Nebraska-Wyoming, in the irrigation season of 1916 and thereafter for the irrigable lands of said project shown on the farm unit plats of: Sixth principal meridian, T. 23 N., R. 53 W.; T. 22 N., R. 53 W.; T. 22 N., R. 52 W.; T. 21 N., R 52 W.; T. 22 N., R. 51 W.; T. 21 N., R. 51 W., approved by the Secretary of the Interior on November 23, 1915, and on file in the local land offices at Alliance, Nebr., and in the office of the project manager at Mitchell, Nebr.

2. This public notice applies only to the unentered lands and lands heretofore entered but relinquished or abandoned, shown on the above plats.

3. Homestead entries of the farm units shown on said plats embracing public lands of the United States may be made on and after March 24, 1916, at 9 o'clock a. m., at the local land office, if found regular and accompanied by the certificate of the project manager, showing that water-right application has been filed and the proper water-right charges deposited.

4. Warning is hereby expressly given that no person will be permitted to gain or exercise any right whatever under any settlement or occupation begun prior to 9 o'clock a. m. March 24, 1916, on any lands shown on said plats: *Provided, however*, That this shall not interfere with any valid existing rights obtained by settlement or entry while the land was subject thereto. All persons desiring to acquire any public lands shown on said plats shall execute homestead application subject to the provisions of the reclamation act in the manner required by law, which, with the required fees and commissions, accompanied by certificate of the project manager as to the filing of water-right applications and payment of water-right

charges as hereinafter provided, shall be presented to the local land office at Alliance, Nebr., in person, by mail, or otherwise within a period of five days prior to March 24, 1916; that is, beginning not earlier than March 19, 1916. All entries filed as herein provided and reaching the local land office not later than 9 o'clock a. m. on March 24, 1916, shall be held and treated as simultaneously filed. Applications presented after that hour will be received and noted in the order of filing. Any application not based on a prior settlement right will be subject to valid settlement claims asserted in the manner required by law.

5. The register and receiver will carefully compare all applications simultaneously filed as aforesaid and will dispose of them as follows:

(*a*) Where there is no conflict, the application shall be allowed irrespective of whether settlement is alleged.

(*b*) In case of conflicting applications and only one of the applicants alleges prior settlement, his application shall be allowed and the others rejected.

(*c*) If two or more conflicting applications are received each containing allegations of prior settlement, a hearing shall be ordered to determine the priority of right, and it shall be restricted to those alleging such right.

6. Where there are applications conflicting in whole or in part in which no one of the several applicants claims prior settlement, the register and receiver will write on cards the names of the several applicants and each of these cards shall be placed in an envelope upon which there is no distinctive or identifying mark, and at 2 o'clock p. m. on the date of opening the entry, if practicable, if not, at same hour one week later, after all the envelopes containing the names of the several applicants shall have been thoroughly mixed in the presence of such persons as may desire to be present, they shall be drawn and numbered in order. The cards as numbered and drawn will be securely fastened to the applications of the respective persons and the applications shall be allowed in such order. Where any applicant fails to obtain land applied for by him, he will be permitted to elect whether he will amend his application to embrace other lands not affected by pending applications and otherwise subject thereto when such amended application is presented, or withdraw his original application without prejudice and in the event of such withdrawal the fees and commissions will be returned by the receiver and any water-right charges deposited will be returned by the project manager of the Reclamation Service. Applications conflicting in whole with those previously allowed will be rejected in the usual manner.

7. The project manager will receive water-right applications accompanied by the proper water-right payments, which for the first payment will be accepted in the form of drafts on New York or Denver, or money order payable to the chief clerk, United States Reclamation Service, Mitchell, Nebr., and issue certificates to applicants for public lands at any time after the date of this notice. Each application must be for a specific farm unit. More than one person may make application for the same farm unit. Filing of water-right application and issuance of certificate gives no preference right to make entry. Acceptance of application will be indorsed thereon by

the project manager when notified by the local land office that entry has been allowed. All other applications, with payments made, will be returned to applicants upon surrender by them of the certificate of filing issued by the project manager.

8. The limit of area per entry representing the acreage which, in the opinion of the Secretary of the Interior, may be reasonably required for the support of a family upon such lands is fixed at the amounts shown upon the plats for the several farm units. All water-right applications must be made to the project manager, United States Reclamation Service, Mitchell, Nebr.

9. The water-right charges per acre of irrigable land are of two kinds, (*a*) a charge of $55 per irrigable acre for the building of the irrigation system, termed the construction charge, and (*b*) an annual charge for operation and maintenance, payable March 1 of each year for the preceding irrigation season. The operation and maintenance charge for the irrigation season of 1916 shall be due March 1, 1917, and shall be of the amount and terms of payment announced for the said project.

10. For homestead entries made hereunder an initial payment of 5 per cent, or $2.75 per irrigable acre, on account of the construction charge shall be made at the time of entry or filing of water-right application, which application must be on the form provided under the reclamation extension act. The remainder of the construction charge, $52.25 per irrigable acre, must be paid in 15 annual installments, the first 5 of which shall each be 5 per cent (or $2.75 per irrigable acre each), and the remainder each 7 per cent (or $3.85 per irrigable acre each). The first of said annual installments shall become due and payable on December 1 of the fifth calendar year after the initial installment, and subsequent installments shall become due on December 1 of each calendar year thereafter.

11. Any water-right applicant or entryman may, if he so elects, pay the whole or any part of the construction charges owing by him within any shorter period than that provided by the public notices and orders applicable to his land.

12. All water-right charges must be paid at the office of the United States Reclamation Service, at Denver, Colo., except as provided in paragraph 7. Drafts on New York or Denver, money orders, checks, etc., should be made payable to the disbursing officer, United States Reclamation Service, Denver, Colo.

13. The method of determining the annual operation and maintenance charges, the penalties for failure to pay the construction charge and the operation and maintenance charges when due, and discount allowed for prepayment of operation and maintenance charges for all lands shall be as prescribed by the act of August 13, 1914.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

ORDER, FEBRUARY 10, 1916.

1. Whereas section 11 of the act of Congress approved August 13, 1914 (38 Stat., 686) provides:

> That whenever water is available and it is impracticable to apportion operation and maintenance charges as provided in section five of this act the Secretary of the Interior may, prior to giving public notice of the construction charge

per acre upon land under any project furnish water to any entryman or private landowner thereunder until such notice is given making a reasonable charge therefor, and such charges shall be subject to the same penalties and to the provisions for cancellation and collection as herein provided for other operation and maintenance charges.

2. Therefore it is hereby provided that water will be furnished on a rental basis in the irrigation season of 1916 to private lands, to lands entered prior to January 13, 1916, and not relinquished or abandoned, shown on the following farm unit plats, viz: Sixth principal meridian, T. 21 N., Rs. 51 and 52 W.; T. 22 N., Rs. 51, 52, and 53 W.; T. 23 N., R. 53 W., approved by the Secretary of the Interior November 23, 1915, the said lands being under the low line canal, North Platte project, Nebraska-Wyoming. Water will be furnished to the said lands under the provisions of the reclamation law, and particularly the terms of section 11 of the reclamation extension act of August 13, 1914 (38 Stat., 686). The charge for such water will be 40 cents per acre-foot measured at the land, payable as provided in section 11 of the reclamation extension act.

3. Persons desiring to avail themselves of the privilege of securing such water service must make application therefor on forms duly approved for this purpose and on file in the office of the project manager, Mitchell, Nebr.

4. Payments for water service hereunder for any irrigation season shall be due on March 1 of the year following.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, FEBRUARY 24, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix due date or operation and maintenance charges, notice is hereby given that hereafter until further notice for all lands under the North Platte project, Nebraska-Wyoming, the operation and maintenance charge for any irrigation season shall be due and payable on March 1 of the following calendar year.

2. The operation and maintenance charges for the irrigation season of 1916 shall be due March 1, 1917, and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of $1, which will permit delivery of not more than 1 acre-foot per acre. For the first acre-foot per acre additional the charge shall be at the rate of 25 cents per acre-foot, and should further quantities be needed, they will be furnished at the rate of 30 cents per acre-foot.

3. The provisions of this public notice cover all lands subject to public notice heretofore issued for the said project.

4. Except as hereinabove provided, all the terms and provisions of existing public notices and orders and in particular the public notice of February 27, 1915, for the North Platte project shall remain unchanged.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, MAY 16, 1916.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water will be furnished under the North Platte project, Nebraska-Wyoming, in the irrigation season of 1916 and thereafter for the irrigable lands of said project hereinafter described, shown on farm-unit plats of sixth principal meridian, T. 23 N., R. 53 W.; farm unit A, or lots 3, 4, and 5, sec. 31; farm unit B or W. ½ SE. ¼ SE. ¼, SW. ¼ SE ¼, SE. ¼ SW. ¼, and S. ½ NE. ¼ SW. ¼, sec. 31; T. 22 N., R. 53 W.; farm unit J, or lot 1 and SE. ¼ NE. ¼, sec. 6, approved by the Secretary of the Interior on November 23, 1915, as amended May 4, 1916, and on file in the local land office at Alliance, Nebr., and in the office of the project manager at Mitchell, Nebr.

2. Homestead entries of the farm units above described may be made on and after June 15, 1916, at 9 o'clock a. m., at the local land office, if found regular and accompanied by the certificate of the project manager, showing that water-right application has been filed and the proper water-right charges deposited.

3. Warning is hereby expressly given that no person will be permitted to gain or exercise any right whatever under any settlement or occupation begun prior to 9 o'clock a. m., June 15, 1916, on said lands above described; provided, however, that this shall not interfere with any valid existing rights obtained by settlement or entry while the land was subject thereto. All persons desiring to acquire any public lands above described shall execute homestead application subject to the provisions of the reclamation act in the manner required by law, which, with the required fees and commissions, accompanied by certificate of the project manager as to the filing of water-right applications and payment of water-right charges as hereinafter provided, shall be presented to the local land office at Alliance, Nebr., in person, by mail or otherwise within a period of five days prior to June 15, 1916, that is beginning not earlier than June 10, 1916. All entries filed as herein provided and reaching the local land office not later than 9 o'clock a. m. on June 15, 1916, shall be held and treated as simultaneously filed. Applications presented after that hour will be received and noted in the order of filing. Any application not based on a prior settlement right will be subject to valid settlement claims asserted in the manner required by law.

4. The register and receiver will carefully compare all applications simultaneously filed as aforesaid and will dispose of them as follows:

(*a*) Where there is no conflict, the application shall be allowed irrespective of whether settlement is alleged.

(*b*) In case of conflicting applications and only one of the applicants alleges prior settlement, his application shall be allowed and the others rejected.

(*c*) If two or more conflicting applications are received, each containing allegations of prior settlement, a hearing shall be ordered to determine the priority of right, and it shall be restricted to those alleging such right.

5. Where there are applications conflicting in whole or in part in which no one of the several applicants claims prior settlement, the register and receiver will write on cards the names of the several applicants and each of these cards shall be placed in an envelope upon which there is no distinctive or identifying mark, and at 2 o'clock p. m. on the date of opening the entry, if practicable (if not, at the same hour one week later), after all the envelopes containing the names of the several applicants shall have been thoroughly mixed in the presence of such persons as may desire to be present, they shall be drawn and numbered in order. The cards as numbered and drawn will be securely fastened to the applications of the respective persons, and the applications shall be allowed in such order. Where any applicant fails to obtain land applied for by him, he will be permitted to elect whether he will amend his application to embrace other lands not affected by pending applications and otherwise subject thereto when such amended application is presented, or withdraw his original application without prejudice, and in the event of such withdrawal the fees and commissions will be returned by the receiver, and any water-right charges deposited will be returned by the project manager of the Reclamation Service. Applications conflicting in whole with those previously allowed will be rejected in the usual manner.

6. The project manager will receive water-right applications accompanied by the proper water-right payments, which will be accepted in the form of drafts on New York or Denver, or money order payable to the special fiscal agent, United States Reclamation Service, Mitchell, Nebr., and issue certificates to applicants for public lands at any time after the date of this notice. Each application must be for a specific farm unit. More than one person may make application for the same farm unit. Filing of water-right application and issuance of certificate gives no preference right to make entry. Acceptance of application will be indorsed thereon by the project manager when notified by the local land office that entry has been allowed. All other applications, with payments made, will be returned to applicants upon surrender by them of the certificate of filing issued by the project manager.

7. In all other respects, including the amount of charges and dates of payment, the public notice dated January 13, 1916, will apply, except that until further notice all water-right charges shall be paid to the officer designated in paragraph 6.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 717.]

Feature costs of North Platte (Fort Laramie) project, Nebraska-Wyoming, to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys		$61,004.79
Storage works:		
Pathfinder Reservoir	$1,824,042.64	
Lake Alice Reservoir	209,730.19	
Minatare Reservoir	552,106.15	2,585,878.98
Canal system:		
Whalen Diversion Dam	235,010.54	
First division, Interstate Canal	1,033,706.97	
Second division, Interstate Canal	849,340.29	
Third division, Interstate Canal	447,004.84	2,565,062.64
Lateral system:		
Rawhide lateral district	3,819.31	
Lateral system No. 1	359,652.94	
Lateral system No. 2	285,034.79	
Lateral system No. 3	283,796.39	932,303.43
Drainage system:		
Preliminary and general work	14,571.81	
Open drains	50,026.60	
Closed drains	73,081.03	
Miscellaneous	15,555.76	153,235.20
Farm units, surveys		43,003.29
Permanent improvements and lands		57,369.17
Operation and maintenance during construction		428,457.18
Plant accounts		36,207.58
Operation and maintenance charges transferred to and compounded with construction charges		81,348.25
Gross cost of construction of project to June 30, 1916		6,943,870.51
Less revenue earned during construction period:		
Rental of buildings	5,184.68	
Rental of grazing and farming lands	8,314.44	
Rentals of irrigation water	19,328.30	
Contractors' freight refunds	15,551.80	
Forfeitures by defaulting bidders and contractors	16,305.00	
Other revenues, unclassified	1,902.79	
Loss on mess house operations	[1] 12,690.93	
Profit on mercantile store operations	4,806.93	
Profit on hospital operations	6,366.83	
Amounts set up as reserves or depreciation charged to cost and not expended		65,069.84
Net cost of construction of project to June 30, 1916		6,878,807.67

[1] Deduct.

Feature costs of North Platte (Fort Laramie) project, Nebraska-Wyoming, to June 30, 1916.

Features.	Sub-feature.	Principal feature.
Examination and survey		$21,592.64
Canal system:		
Preliminary	$14,387.43	
Whalen Diversion Dam	530.34	
Main Canal excavation	240,151.34	
Minor structures	3,542.54	
Siphons	2,727.26	
Culverts	2,594.42	
		263,933.33
Farm units, surveys		306.89
Permanent improvement and lands, survey		59.30
Plant accounts		26,003.19
Gross cost of construction of project to June 30, 1916		311,895.35
Add losses on incidental operations during construction period:		
Rental of buildings	[1] 201.00	
Profit on mess house operations	726.76	
		525.76
Net cost of construction of project to June 30, 1916		312,421.11

[1] Deduct.

Estimated cost of contemplated work, North Platte (interstate) project, during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Canal system, right of way		$5,000
Lateral system, extensions		5,000
Drainage system:		
Sheep Creek drain	$30.000	
Winters Creek drain	17,000	
McAllister drain	600	
Investigation	4,400	
Other drains	44,000	
		96,000
Permanent improvements and lands		3,000
Operation and maintenance under public notice		130,000
Messes		9,000
Hospitals		3,000
Total		251,000

Estimated cost of contemplated work, North Platte (Fort Laramie unit) project, during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Canal system:		
Location surveys, topography and cross-section	$10,000	
Headworks (separate from dam)	30.000	
Tunnels, wasteways, checks, culverts, bridges, siphons, etc	660.990	
Main Canal	575,910	
		$1,276,900
Lateral system:		
Location surveys and topography	40.000	
Headworks	5.000	
Laterals and sublaterals	22.600	
Turnouts, drops, flumes, bridges, etc	22,400	
		90,000
Farm units		3,600
Permanent structures and land		13,000
Messes		5,000
Mercantile stores		1,000
Hospitals		500
Total		1,390,0

NEVADA, TRUCKEE-CARSON PROJECT.

F. G. HOUGH, project manager, Fallon, Nev.

LOCATION.

Counties: Churchhill, Storey, and Lyon.

Townships: 17 and 18 N., Rs. 17 to 30 E.; 19 N., Rs. 26 to 31 E.; 20 N., Rs. 22 to 31 E., Mount Diablo meridian.

Railroad: Southern Pacific.

Railroad stations and estimated population, January 1, 1916: Fernley, 60; Hazen, 200; Fallon, 1,200; Lahontan, 15; Stillwater, 50.

WATER SUPPLY.

Source of water supply: Truckee and Carson Rivers.

Area of drainage basin: 3,450 square miles.

Annual run-off in acre-feet: Truckee River at Tahoe (519 square miles), 1901 to 1915, maximum 704,000, minimum 113,000, mean 278,500. Truckee River near Vista and Clark (1,740 square miles), 1900 to 1915, maximum 1,435,000, minimum 356,000, mean 819,500. Carson River at Empire (988 square miles), 1901 to 1914, maximum 731,000, minimum 172,000, mean 394,500.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which service is prepared to supply water, season of 1916: 69,100 acres.

Area under water-right applications and rental contracts, season of 1916: 46,998 acres.

Length of irrigation season: From April 1 to October 15—198 days.

Average elevation of irrigable area: 4,000 feet above sea level.

Rainfall on irrigable area: Average 4 inches (maximum record 1913, 8.08 inches).

Range of temperature on irrigable area: 22° to 100° F.

Character of soil of irrigable area: Exceedingly variable; sand, sandy loam, clay, adobe, and volcanic ash.

Principal products: Alfalfa, small grain, potatoes, onions, sugar beets, truck crops, and dairy products.

Principal markets: Nevada and Pacific coast communities.

LANDS OPENED FOR IRRIGATION.

Dates of public notices and orders: May 6, November 1, 1907; January 30, April 4, June 5, December 26, 1908; March 1, September 28, 1909; April 26, September 16, 1910; April 22, October 17, 1911; February 8, June 13, 1912; January 17, June 23, July 15, July 21, 1913; August 19, December 16, 1914; January 30, February 26, March 20, May 13, November 12, 1915; January 17, February 11, 1916.

Location of lands opened: Ts. 17 to 20 N., Rs. 23 to 31 E., Mount Diablo meridian.

Present status of irrigable lands.

	Acres.
Public homestead:	
Entered	18,401
Open to entry	4,340
Withdrawn	100,729
Total	123,520
Indian:	
On approved plats	4,077
Not shown on plats	563
Total	4,640
Private:	
Covered by water-right application	8,698
Open to water-right application	8,620
Not shown on plats	13,984
Total subject to water-right application	31,302
Settled vested rights	13,083
Unsettled vested rights	6,340
Total vested lands	19,423
Total private lands	50,725
State, not shown on plats, total	215
Railroad:	
Covered by water-right application	2,042
Open to water-right application	1,648
Not shown on plats	23,210
Total railroad lands	26,900
Total, entire project	206,000

Limit of area of farm units: 40 to 160 acres.

Duty of water: 3 acre-feet per acre per annum at the farm.

Building charge per acre of irrigable lands: $22, $30, and $60.

Annual operation and maintenance charge per acre of irrigable land: Approximately $1 per acre, based on cost of service.

CHRONOLOGICAL SUMMARY.

Reconnoissance made and preliminary surveys begun in 1902.

Construction recommended by director March 7, 1903.

Construction conditionally authorized by Secretary March 14, 1903.

Truckee Canal completed June, 1905.

Carson River headworks and main distributing canals completed September, 1905.

First irrigation by Reclamation Service season of 1906.

Truckee Canal chute completed November, 1910.

Lahontan Dam commenced January, 1911.

Lahontan Dam completed June, 1915.

United States took possession of outlet works at Lake Tahoe and assumed control July 1, 1915.

Project manager instructed by Reclamation Commission to take preliminary steps toward preparation of unentered farm units for irrigation and cultivation April 19, 1916.

Entire project 63.1 per cent completed June 30 ,1916.

IRRIGATION PLAN.

The irrigation plan of the Truckee-Carson project provides for the storage of water on the headwaters of Truckee River, in Lake Tahoe, in the Alkali Flat Reservoir, near Churchill, Nev., and in Lahontan Reservoir on Carson River;

the diversion of water from Truckee River by a dam about 20 miles below Reno, Nev., into the Truckee Canal, supplying water to lands in the Truckee and Carson River valleys and to the Lahontan Reservoir; the diversion of water from Carson River by a dam near Dayton, Nev., for storage in Alkali Flat Reservoir and irrigating lands in Churchill Valley below that reservoir; and the diversion of water from Carson River by a dam about 5 miles below the Lahontan storage dam into two canal systems, one on either side of the river, watering lands in the lower Carson River Valley. The United States intends, for and in connection with the project, to use the waste, seepage, spring, and percolating water arising within the same, and asserts a right thereto by virtue of its reservation of all unappropriated waters of the project source of supply and of its appropriation of said waters heretofore made for the purposes of the project in accordance with the State law.

The features of the above irrigation plan which have been completed are: The dam at the outlet of Lake Tahoe, including the greater portion of the accessory dredging of the Truckee River Channel; the diversion dam in Truckee River near Derby, Nev., the Truckee Canal carrying water from this diversion 31 miles to the terminal concrete chute discharging into the Lahontan Reservoir; the forebay for the hydroelectric plant discharging Truckee Canal water into Carson River below Lahontan Dam; the diversion dam in Carson River situated about 5 miles below Lahontan Dam; that portion of the irrigation system which includes laterals taking out of Truckee Canal in the vicinity of Fernley and Hazen; and the two main canals heading at Carson diversion dam and extending over the main portions of the project in Carson sink, with Fallon as a center.

Construction of Lahontan Dam and Reservoir was completed in June, 1915, for the conservation of the flood waters in both the Truckee and Carson Rivers.

The features remaining for future construction are: The Alkali Flat Reservoir, or equivalent reservoirs in the upper Carson Valley, as may later be determined; the upper Truckee storage reservoirs as required; the extension of the irrigation system to cover additional irrigable areas adjacent to and on all sides of the project as already constructed; and the extension of the drainage system which may become necessary as supplemental construction in behalf of the water users under the provisions of the reclamation extension act.

SUMMARY OF GENERAL DATA FOR TRUCKEE-CARSON PROJECT TO JUNE 30, 1916.

Areas:		
Irrigable acreage when project is complete		206,000
Public land entered, June 30, 1916	18,401	
Public land open to entry, June 30, 1916	4,340	
Public land withdrawn, June 30, 1916	100,779	
State land, June 30, 1916	180	
Indian land, June 30, 1916	4,640	
Private land, June 30, 1916	77,660	
Acreage service could have supplied season of 1915		65,000
Addition in fiscal year 1916		4,100
Estimated addition in fiscal year 1917		5,000
Estimated acreage service can supply July 1, 1917		74,100
Acreage actually irrigated, season of 1915		40,295
Acreage cropped under irrigation, season of 1915		38,495
Crops:		
Value of irrigated crops, season of 1915		$592,523
Value of irrigated crops, per acre cropped		[1] $15.39
Finances:		
Estimated cost of completed project		$9,436,000
Total construction cost to June 30, 1916		$5,946,844.79
Per cent complete, June 30, 1916		63.1
Appropriation for fiscal year 1917, total		$280,000
Allotment for construction, fiscal year 1917		$188,000
Estimated per cent complete, June 30, 1917		65
Announced construction charges per acre		$22, $30, $60

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[1] $22.65, eliminating native pasture and other areas not in full production.

Finances—Continued.

Appropriation, fiscal year 1916			$236,000
Expenditures during fiscal year, chargeable to 1916 appropriation:			
Disbursements	$68,500.34		
Transfers	9,184.93		
		$77,685.27	
Registered liabilities chargeable to 1916 appropriation		12,785.24	
			$90,470.51
Unencumbered balance, July 1, 1916			$145,529.49

Repayments:

Construction charges—	
Accrued to June 30, 1916	$295,885.78
Collected to June 30, 1916	$291,123.40
Uncollected, June 30, 1916	$4,762.38
Operation and maintenance charges (public notice)—	
Accrued to June 30, 1916	$214,687.53
Collected to June 30, 1916	$197,701.60
Uncollected, June 30, 1916	$16,985.93
Water rental charges—	
Accrued to June 30, 1916	$42.50
Uncollected, June 30, 1916	$42.50
Power earnings—	
Accrued to June 30, 1916	$27,445.95
Collected to June 30, 1916	$25,715.70
Uncollected, June 30, 1916	$1,730.25

Drainage:

Estimated acreage damaged by seepage to June 30, 1916		10,000
Miles of drains built to June 30, 1916:		
Open	179.64	
Closed	3.79	
Total		183.43
Estimated acreage protected by drains built to June 30, 1916		10,400
Expended to June 30, 1916, on drainage works completed and uncompleted		$296,193.23

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

MAIN LOWER TRUCKEE CANAL.

The first work undertaken on the Truckee-Carson project was the construction of a canal, known as the main lower Truckee Canal, to divert water from Truckee River and convey it in part to the Carson River and in part for the irrigation of adjacent lands. This canal is 31 miles in length and has a capacity of 1,500 second-feet at the intake, and of 1,200 second-feet at its end where it discharges into the Carson River. For about 10 miles the canal passes along the steep sides of the canyon of Truckee River, where concrete lining was required in many places and where three tunnels were needed, aggregating about 2,700 feet in length. For the remaining distance, the canal is in earth section and in general offered little difficulty in construction.

The diversion dam on Truckee River comprises a set of 16 concrete sluiceways and an earth-fill dam 1,160 feet in length.

Plans and specifications for the construction of the main Truckee Canal and headworks were approved by the department in May, 1903, and proposals were opened July 15. The work was divided into three divisions, the first embracing the diversion dam, the headworks of the canal, a portion of the canal excavation in the canyon, and the Pyramid branch headworks; the second division including the remaining canal excavation in the canyon, with the tunnels and wasteways; and the third division consisting of canal excavation only for about 20 miles through the valley. Contracts were executed for divisions 1 and 2 on September 3, 1903, and for division 3 on August 28, 1903. The work on division 1 was completed in June, 1905; that on division 2 in April, 1905; and that on division 3 in September, 1904.

Truckee Canal check structures.—In the fiscal year 1912 a concrete structure with wooden needles was constructed below Fernley for the purpose of checking the water in the Truckee Canal and enabling the discharge of sufficient quantities into the laterals supplying the Fernley district. A wooden structure for the same purpose was built into a rock cut of the main canal opposite Hazen.

Road work along Truckee Canal.—The rainstorms of 1913 emphasized the necessity for greater accessibility of Truckee Canal. During the fall and winter a small force completed the grading of the canal banks throughout the canyon section below Derby, over the Gillpin spillway, and around the three canal tunnels, to complete a serviceable road traversing the entire canal. About 3 miles of new highway were graded from Lahontan westward to a connection with the main road to Dayton as a substitute for an equivalent length of road which is now submerged in Lahontan Reservoir.

TRUCKEE DIVERSION DAM.

To provide for the free passage of all ordinary drift there was constructed during the winter of 1911–12 a spillway in the middle of the dam which gives a clear opening of 15 feet in width by 10 to 12 feet in height, made by removing the upper portion of one of the piers between the gates and providing stop planks and needles for the control of the water at any desired elevation necessary for the operation of the Main Truckee Canal. In conjunction with this spillway construction a complete repair and reconstruction of the fish ladder was undertaken.

TRUCKEE CHUTE.

The temporary chute at the end of the canal for discharging its waters into Carson River was built by Government forces in the year 1905. In the spring of 1910 the construction of a permanent concrete structure for this purpose was begun by Government forces. The complete structure includes an approach section 300 feet long of open-lined canal leading into a long rectangular forebay with a weir crest along either side and a set of flashboard gates across the end of the fore bay. The discharge over each weir crest falls into a tailrace channel paralleling the crest, the two coming together in a funnel-shaped channel below the flashboard gates which connects smoothly into the regular length of 141 feet. The chute proper begins at this point with a channel of ordinary canal section with flat bottom and 1 to 1 side slopes, but modified by having the angle between the side and bottom smoothed out by a curve and the upper part of the slope curved up to a vertical face. This section continues for 210 feet, then in the next 74 feet it changes by warping into a rectangular cross section 10 feet wide, which runs for 357 feet, and then changes to 9 feet in width in the final 40 feet. The end is built as a cantilever, overhanging 18 feet and strongly anchored to a heavy anchor block under the adjoining upstream portion. The total length of the structure is 1,122 feet, and of the chute proper, 681 feet. The drop from maximum water level in canal to end of chute is 52 feet. At the end of the chute the water drops on a rocky slope and finds its way down this slope to the river.

CARSON RIVER DIVERSION WORKS AND MAIN DISTRIBUTING CANALS.

On Carson River, about 4 miles below the end of the Truckee Canal, are located the headworks of the main distributing canals of the project. Diversion is accomplished by means of concrete regulator sluiceways across the river and concrete canal headworks with rising weir gates. The dam or regulating works contain 23 gate openings, each 5 feet wide. At the south end of the dam is the intake of a canal having an initial capacity of 1,500 second-feet, and at the north end is located the intake of a canal having an initial capacity of 500 second-feet. The intake for the south side canal is controlled by three steel rising weirs, each 15 feet long and 5 feet high, and the intake for the north side canal has one such rising weir. The south side canal constitutes the main canal system and extends for a distance of about 22 miles, and, together with the necessary laterals and distributing ditches, will irrigate a large amount of land on the south side of the river. The canal in its course crosses both the South Branch and New River, which are channels carrying parts of the natural flow of Carson River. About 7 miles from the head of the canal is located a drop in the canal line of 6.74 feet, in connection with which there is a wasteway designed for returning any desired portion of the canal flow to South Branch. The north side distributing canal serves lands north of Carson River and northwest of Old River branch. Both of the distributing canals have concrete structures for diverting water into laterals at various places.

Early in 1904 plans and specifications were prepared for the construction of the distributing canals and structures, including the headworks on Carson River. These plans and specifications were approved by the department April 15, 1904, and proposals for the work were opened July 15, 1904. Four contracts were executed, as follows: For bridges, on August 19, 1904; for the excavation work, on September 9, 1904; for the head gates and other structures, except the Carson River headworks, on September 17, 1904; and for the Carson River headworks, on September 29, 1904. The work was begun promptly on all of the contracts and was carried on during the fall of 1904 and the early season of 1905. The bridges were completed in March, the excavation in June, the Carson River headworks in July, and the other structures in September, 1905.

LATERAL-DISTRIBUTION SYSTEM.

The lateral system for the distribution of waters from the main distributing canals to the lands to be irrigated is divided into seven divisions or districts, supplying from 20,000 to 50,000 acres of land each. On November 17, 1904, the department approved plans and specifications for the construction of about 150 miles of lateral-irrigation canals, together with necessary structures. Proposals were received December 15, 1904, and three contracts were executed for different parts of the work on, respectively, January 21, 24, and 30, 1905. The contracts were completed during the season of 1905 and 1906. In connection with the structures for these laterals there was included the construction of a large concrete drop on the main south side distributing canal about 6 miles below the head of the canal.

Other plans and specifications for extension of laterals and the building of structures were approved by the department on March 9, 1906, and July 27, 1906. No proposals were received under the advertisement for either of these sets of specifications, and the work was authorized to be done by Government forces, and was completed in the seasons of 1906 and 1907. Slight additional extensions of the distributing laterals and the building of a few additional structures were carried on during the seasons of 1908 and 1909, when the distribution system for the irrigation of the first unit of the project, containing about 90,000 acres of irrigable lands, was practically completed.

In the fiscal year 1914 the construction of the H lateral, of approximately 50 second-feet capacity, for irrigating about 2,000 acres of land in the Douglass Island district was completed under small contracts with the farmers for a distance of about 3 miles, except two sections of 1,000 feet each, which were temporarily omitted on account of wet ground during the irrigation season. In the Stillwater district the Kemp-Winder lateral for watering about 500 acres south of Stillwater Slough was completed and put into operation in the season of 1914. Sections of other smaller laterals were built here and there in the project for individual delivery under water-right application.

LAKE TAHOE RESERVOIR.

On April 29, 1905, the department approved plans and specifications for the construction of outlet controlling works for Lake Tahoe. Proposals were opened on June 15, 1905, and a contract was executed for the work on July 5. Shortly after the contractor began work he was stopped by an injunction secured by landowners in the vicinity of the outlet. Settlement was finally made with the contractor and the work abandoned for the time. In 1909, however, under a proposed contract with one of the power companies utilizing water from Lake Tahoe the construction of regulating works was begun by the company and partially completed.

Lake Tahoe Dam.—The outlet property at Lake Tahoe was subject to a suit for condemnation by the United States, but in the summer of 1913 an agreement was made with the Truckee River General Electric Co., the owner of the property, to resume construction work on the dam at the lake outlet without prejudice to the rights of either party to the suit. Accordingly, in August, 1913, the Truckee River

General Electric Co. resumed work on the remaining portion of the dam which had been commenced in the fall of 1909 under plans and specifications at that time approved by the United States Reclamation Service.

The dam, consisting of a reinforced concrete framework for inclosing the 17 sluice gates and surmounted by a wooden superstructure for sheltering the gate mechanism, was completed in the following October.

The accessory dredging of the river channel above the dam, including the removal of old cofferdams and other débris, together with necessary grading and riprapping about the ends of the dam, was completed in November, and the construction plant removed.

The completion of this reinforced concrete dam as a substitute for the old timber dam built about 40 years previously finally accomplished the original design of the Reclamation Service for the control of Lake Tahoe levels within a reasonable limit of fluctuation.

LAHONTAN DAM.

Construction of the Lahontan Dam was approved by the Secretary of the Interior on December 31, 1910. Work was begun on the dam in January, 1911, and the dam was completed in June, 1915, at a cost of approximately $1,500,000.

The dam is of the earth and gravel fill type, 1,300 feet in length, with a maximum height of 124 feet above the stream bed, in addition to 80 feet depth of cut-off wall extending below the bed of the river. The embankment is 20 feet wide on top, with an upstream slope of 3 to 1 protected by 2 feet of riprap, and a downstream slope of 2 to 1 protected by 12 inches of riprap. The concrete spillways, each 250 feet long, one on each side of the river, flank the embankment proper. Down the steps of these spillways the waste water flows to a central circular concrete pool in the river bed near the toe of the dam. This pool, 220 feet in diameter and 30 feet deep, serves to retard the velocity of the water sufficiently to allow its discharge into the old river bed without danger of eroding the soil. The outlet works consist of twin concrete conduits 9 feet in diameter, and are operated by hydraulic oil-pressure apparatus in the gate tower at the upper end of the conduits. The entire top of the dam is curbed and paved with concrete and provided with a massive concrete railing carrying electric-light fixtures for night illumination. A stalwart suspension bridge connects the outlet tower to the top of the dam.

Other features of the dam are a special outlet tower, controlling gate, and reinforced-concrete pipe 4 feet in diameter through which water can be supplied for the operation of the hydroelectric plant if necessary. A reinforced-concrete siphon pipe, also 4 feet in diameter, with necessary gates and outlets, takes water from the Truckee Canal across and beneath the Carson River to the Lahontan Bench Canal. This canal will supply irrigation water to the "Bench" lands when opened for entry.

With the exception of a couple of steam shovels and four narrow-gage locomotives, the entire construction plant was operated by electricity, power being furnished by a hydroelectric plant of 1,000 kilowatts capacity.

The quantities of work involved in the construction of Lahontan Dam were: Excavation, 284,000 cubic yards; embankment, 663,000 cubic yards; paving, 31,000 cubic yards; concrete, 70,800 cubic yards; and iron and steel, 800 tons. The capacity of the resulting reservoir is 290,000 acre-feet of water.

LAHONTAN-FALLON TRANSMISSION LINE.

Sixteen miles of 30,000-volt transmission line from Lahontan to Fallon were completed by contract in the fiscal year 1913, connecting with step-down transformers installed in the concrete-block substation building, which was built by contract at Fallon and completed ready for the delivery of electric current in September, 1912. Since that time uninterrupted service has been supplied to the city of Fallon under the 10-year contract.

DRAINAGE CONSTRUCTION.

In the fiscal year 1913 an open-cut drain 1 mile long, averaging about 5 feet in depth, was excavated for the relief of 5 homestead tracts south and east of Fallon. Other smaller drain extensions were made in connection with annual cleaning of drains. Ground water surveys were made as a guide to the location of the first 4 miles of deep-drainage system. About 4 miles of vitrified clay pipe, 8 to 15 inches in diameter, were purchased and delivered at Fallon for installation in the deep-drainage system. The work was advertised for contract, but as no bids were received, preparations were made for doing the work by Government forces. To this end a gasoline power drag-line excavator, suitable for the purpose, was purchased for delivery about the end of the fiscal year.

About 13,000 feet of open and 15,000 feet of closed drains were constructed during the fiscal year 1914; the closed drains are of 12-inch and 15-inch tile placed at an average depth of 8 feet. These drains were dug in order to determine the most effective depth and type of drain for controlling the ground waters over the project.

CONSTRUCTION DURING FISCAL YEAR.

Lateral construction.—The construction of several small laterals and enlargement of others for supplying water to second-unit lands was completed, including the necessary installation of farm takeout and other minor structures. This construction was for lands opened under public notice, as listed for the fiscal year. The "AD" drain extension was also completed. The excavation was done with a Monighan gasoline dragline excavator, which with a 1 cubic-yard bucket made a daily average of 527 cubic yards.

Drainage construction.—Some 2,000 linear feet of the "AD" drain were cleaned, using a gasoline excavating machine. The construction of the "AD" drain extension was commenced in March, 1916, and completed in June; 43,108 cubic yards of material were excavated in 8,679 linear feet of this drain. This extension was made for the relief of second-unit lands, which bore the construction expense.

This drain is a deep open cut drain. During the year preliminary drainage surveys and estimates were made in the Fernley and "AA" districts and in the extension of the S-1 drain system in District No. 5.

Miscellaneous.—During July, August, and September about 150 well borings, ranging in depth from several feet to over 100 feet, were made in connection with underground water studies for the Soda lakes investigation. Measurements were made in these wells at regular intervals to determine the ground-water elevation, practically throughout the year.

A special topographic survey of a portion of Lake Tahoe shore line was undertaken in November, and, although seriously retarded by snow, was finally completed.

Construction started on a ditch-tender's house in Stillwater district and on a log house for the gate tender at Lake Tahoe.

Squatters' cabins were removed from Government property at Lake Tahoe.

Preliminary studies were started for proposed leveling of farm units by Government in advance of settlement. Engineering studies in connection with the Truckee River water right and the proposed drainage district at Fernley were also continued.

SEEPAGE AND DRAINAGE.

The question of drainage of lands rendered unfit for cultivation through seepage has increased to such an extent that it now presents a difficult problem. The agricultural census for 1915 reported 2,213 acres unsuitable for plant growth; part of this acreage produced a 25 per cent crop during 1914. In addition to the above many acres are gradually declining in production. This condition is in part due to the excess quantity of water used in irrigation by ranchers, many of whom are ignorant of the proper method of irrigating. Experiments being conducted in the Fernley district have proven that a normal crop can be grown in that district with two-fifths to one-half the amount of water ordinarily used if it is applied in a scientific manner. This means capacious ditches, large heads, and a rapid irrigation with subsequent drainage of superfluous water.

A careful survey and study of the situation reveals the only solution to lie in deep open-cut drains. Already several have been constructed from which the beneficial effect upon adjacent lands has been almost instantly noticeable. Plans are well advanced for a system of drains which it is expected will remedy the deleterious effect of a high-water level caused by seepage or faulty irrigation.

ECONOMIES OF GOVERNMENT WORK.

Two notable illustrations of economies of Government work appeared in the construction of Lahontan Dam: First, the hydroelectric power plant; and second, the sand-cement plant.

The site of Lahontan Dam is at the confluence of the Truckee Canal with the Carson River. A drop of some fifty-odd feet offered ideal opportunity for power development, and this was utilized through the installation of two Pelton water wheels developing 1,000 kilowatts. The plant was completed in December, 1911, and was operated continuously since that date for power and lights on the work and in the camp.

While it is difficult to estimate the exact saving which resulted from the use of electrical power, a great economy is apparent when we consider the high price of fuel in this section, and the far greater accessibility and flexibility of electric over steam power.

A sand-cement plant was constructed at Lahontan in 1912 at a cost of approximately $12,200. It consisted of an Allis-Chalmers 5 by 22 foot tube-mill driven by a 100 horsepower motor, and had a capacity of 12 barrels per hour. In this mill Portland cement was blended with Lahontan "silt" or "sand" in the proportion of 50 per cent each and ground in the tube to about 82 per cent through a 200-mesh sieve. In all, 29,305 barrels were manufactured at a total cost of $57,950.92, or $1.9775 per barrel. The equivalent displacement of Portland cement at $2.395 per barrel would amount to $70,185.48. An apparent saving, therefore, of some $12,234.56 resulted from the sand-cement plant.

OPERATION AND MAINTENANCE.

Water supply.—Although the stream yield during the year 1915 was somewhat below normal, Lake Tahoe reached an elevation of 6,229.14 on July 9, 1915, and 87,800 acre-feet of storage in Lahontan Reservoir on July 7, 1915, assured an abundant water supply for the project irrigation.

Snow accumulation early in 1916 reached 226 inches at the summit observation station, with the resulting yield of streams somewhat above normal. Lake Tahoe reached an elevation of 6,229.68 on June 30, 1916, and on the same date Lahontan Reservoir elevation was 4,145.65, representing a storage of 151,650 acre-feet. This storage was gained at a time when the natural stream flow was more than sufficient to supply immediate project irrigation needs and insures against future requirements.

Use of water.—During the 1915 irrigation season 88,388 acre-feet were distributed among water users paying operation and maintenance charges, and 29,845 acre-feet were delivered to lands claiming unsettled vested water rights, paying no operation and maintenance charges. Of the total amount diverted, 38.3 per cent was lost through seepage and evaporation in carriage. The net delivery to farms totalled 118,233 acre-feet, covering an area of 40,295 acres, which is a net duty of 2.94 acre-feet. The net delivery of water to project lands in 1914 was 94,730 acre-feet, with water duty of 3.28 acre-feet for the season.

The main Truckee canal was operated continuously for irrigation and power development, with incidental carriage of surplus water to Lahontan Reservoir.

The "V" and "T" line canals were operated to supply the extensive lateral system, covering about 40,200 acres of irrigated lands centering at Fallon. The operation of the system was in charge of a water master at Fallon, assisted by 10 district ditch tenders, who by means of systematic rotation were enabled to supply the individual needs of the farmers in turn.

Maintenance work.—The maintenance of the distribution system was carried on as usual by a small organization of men and animals, with headquarters at Fallon and extending to all parts of the project, through the cooperation of farmers with their teams when required for supplementary work.

A substantial feature of maintenance work was the repair of ditches due to breaks in levees caused by gophers or muskrats, which were responsible for a large portion of the expense of upkeep on the project. One large break occurred in the Truckee Canal in June 1916, necessitating the replacing of about 5,000 cubic yards of bank. Damage to the Southern Pacific Co.'s railroad tracks and delaying of main-line traffic resulted from this break.

The growth of tules, moss, and other vegetation in laterals and drains was another source of expense. The drying out of ditches early in the season allowed proper cleaning which could not be undertaken in past seasons when ditches were either too wet or frozen up before they could be cleaned. The disk harrow was the most effective and economical method tried for removal of moss and weeds in ditches.

Pasturage of stock on the ditch banks was one method tried with some success for keeping down vegetation, which resulted in the suppression of gophers to a noticeable degree.

The maintenance force installed and repaired structures necessary for the increased area irrigated and operation of the general system.

Historical review, Truckee-Carson project.

Item.	1911	1912	1913	1914	1915	To June 30, 1916.
Acreage for which service was prepared to supply water	52,039	52,039	52,039	52,039	65,000	69,100
Acreage irrigated	30,139	36,620	43,075	43,075	40,295	41,000
Number of farms irrigated	469	497	494	494	540	575
Miles of canal operated	292	294	295	295	300	305
Water diverted (acre-feet)	262,619	170,763	186,175	225,000	233,693	....
Water delivered to land (acre-feet)	143,746	62,707	69,798	94,730	118,233	....
Per acre of land irrigated (acre-feet)	4.46	2.50	2.26	3.28	2.94	....

SETTLEMENT.

During the fiscal year many inquiries were received from prospective settlers regarding project conditions and requirements for making enty on farm units or purchasing land in the community. Many called personally and were taken over the open lands by the settlement agent or others assigned to such duty.

Under public notice of November 12, 1915, the south half of the northeast quarter of section 10, township 20 north, range 24 east, Mount Diablo meridian, was opened to entry and subsequently filed upon. Public notice dated February 11, 1916, opened to entry 55 farm units, comprising 2,842 irrigable acres of land in townships 18 north, range 29 east; 19 north, range 29 east; 19 north, range 30 east; and 19 north, range 31 east. In addition to public land, 2,897 acres of irrigable land in private ownership were made subject to water-right application under the second unit.

Up to June 30, 1916, a total of 24 new filings were recorded; 14 are homesteads and 10 on private land.

Settlement data, Truckee-Carson project.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	497	494	494	540	575
Population		1,635	1,635	1,867	1,990
Number of irrigated farms		494	494	540	575
Operated by owners or managers		439	439	480	500
Operated by tenants		55	55	60	75
Population		1,635	1,635	1,867	1,990
Number of towns	4	4	4	4	4
Population		1,250	1,250	1,400	1,510
Total population in towns and on farms		2,885	2,885	3,267	3,500
Number of public schools	18	18	19	20	19
Number of churches	7	8	8	8	9
Number of banks	1	1	1	1	1
Total capital stock	$100,000	$100,000	$100,000	$100,000	$100,000
Total amount of deposits	$260,000	$300,000	$350,000	$300,000	$342,000
Total number of depositors	550	600	650	700	700
Number of relinquishments	41	12	3	8	1

PRINCIPAL CROPS.

Alfalfa constitutes the great staple crop of this section, with wheat, barley, potatoes, and garden crops in the order named. The production of butter by the Churchill creamery has more than doubled during the last year and additional cows are being imported in large numbers. The Fallon Flour Co. has erected a large and well-equipped mill and is already making trial runs. Winter wheat grown here makes excellent flour, and a permanent and stable prosperity is expected to result from this new enterprise.

Crop report, Truckee-Carson project, Nevada, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield	Total.	Per acre.
Alfalfa hay	18,273	Ton	53,496	2.93	$8.00	$427,968	$23.36
Barley	1,733	Bushel	49,585	28.61	.60	29,750	17.16
Wheat	2,582	...do	54,065	20.94	.90	48,660	18.85
Oats	428	...do	14,375	33.58	.56	8,050	18.80
Potatoes (common)	196	...do	25,133	128.42	.75	18,850	96.17
Garden and miscellaneous	1,575					28,160	17.87
Hay, except above	936	Ton	830	.89	5.50	4,570	4.88
Alfalfa (planted 1915)	2,070	...do	400	.19	8.00	3,200	1.55
Pasture (alfalfa)						11,754	
Pasture (all other)	11,590					11,561	.99
Less duplicated areas	888						
Total cropped acreage.	38,495	Total and average				592,523	[1] 15.39
Irrigated, not cropped	1,800						
Total irrigated acreage.	40,295						

Areas.	Acres.	Farms.	Per cent of project.
Total irrigable area farms reported	58,620	571	28.45
Total irrigated area farms reported	40,295	571	19.56
Total cropped area farms reported.	38,495	571	18.68

[1] $22.65, eliminating native pasture and other areas not in full production.

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, NOVEMBER 12, 1915.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388) and acts amendatory thereof and supplementary thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water will be furnished from the Truckee-Carson project, Nevada, in the irrigation season of 1916 and each irrigation season thereafter upon the filing of proper water-right application for the irrigable lands in farm unit B, or south one-half northeast quarter section 10, township 20 north, range 24 east, Mount Diabolo base line and meridian.

2. Homestead entry of the said farm unit may be made on and after December 3, 1915, at 9 o'clock a. m., at the local land office, if found regular and accompanied by the certificate of the project manager, showing that water-right application has been filed and proper water-right charges deposited.

3. Warning is hereby expressly given that no person will be permitted to gain or exercise any right whatever under any settlement or occupation begun prior to 9 a. m., December 3, 1915. All persons desiring to acquire the said farm unit shall execute homestead application subject to the provisions of the reclamation act in the manner required by law, which, with the required fees and commissions, accompanied by certificate of the project manager as to the filing of water-right application and payment of water-right charges as hereinafter provided shall be presented to the local land office at Carson City, Nev., in person, by mail, or otherwise, within a period of two days prior to December 3, 1915; that is, beginning not earlier than December 1, 1915. All entries filed as herein provided and reaching the local land office not later than 9 a. m. on December 3, 1915, shall be held and treated as simultaneously filed. Applications presented after that hour will be received and noted in the order of filing.

4. The register and receiver will carefully examine all applications simultaneously filed as aforesaid, and in case only one valid application shall have been received such application shall be allowed.

5. In case two or more applications are received for the said farm unit the register and receiver will write on cards the names of the several applicants, and each of these cards shall be placed in an envelope upon which there is no distinctive or identifying mark, and at 2 o'clock p. m. on the date of opening to entry, if practicable (if not, at the same hour one week later), after all the envelopes containing the names of the several applicants shall have been thoroughly mixed in the presence of such persons as may desire to be present, they shall be drawn and numbered in order. The cards as numbered and drawn will be securely fastened to the applications of the respective persons, and the applications shall be allowed in such order. Should any applicant fail to obtain the land he may withdraw his original application without prejudice, and in the event of such withdrawal the fee and commissions will be returned by the receiver and the water-right charges deposited will be returned by the project manager.

6. The project manager will receive water-right applications accompanied by the proper water-right payments, which will be accepted in the form of drafts on New York or Denver, or money order, etc., payable to the disbursing officer, United States Reclamation Service, Denver, Colo., and issue certificates to applicants at any time after the date of this notice. More than one person may make water-right application for the farm unit. Filing of water-right application and issuance of certificate gives no preference right to make entry. Acceptance of the application will be indorsed thereon by the project manager when notified by the local land office that entry has been allowed. All other applications, with payments made, will be returned to applicants upon surrender by them of the certificate of filing issued by the project manager.

7. The charges per acre of irrigable land are of two kinds, namely: (*a*) A charge of $60 per acre for the building of the irrigation system, termed the construction charge; (*b*) an annual charge for operation and maintenance due March 1 of each year. Each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge, which shall be the charge for 1 acre-foot of water.

8. An initial payment of $3 per irrigable acre on account of the construction charge shall be made at the time of making water-right application or entry. The remainder of the construction charge, $57 per irrigable acre, shall be paid in 15 annual installments, the first 5 of which shall be $3 each and the remainder $4.20 each. The first of the said annual installments shall become due and payable on December 1 of the fifth calendar year after the initial installment, and subsequent installments shall become due on December 1 of each calendar year thereafter. Any water-right applicant may, if he so elects, pay the whole or any part of the construction charges owing by him within a shorter period.

9. All water-right charges must be paid at the office of the United States Reclamation Service at Denver, Colo. Drafts on New York or Denver, or money orders, etc., should be made payable to the disbursing officer, United States Reclamation Service, Denver, Colo.

10. The operation and maintenance charge for the season of 1916 shall be based on the quantity of water delivered, with a minimum charge per irrigable acre, whether water is used or not. The amount of such charge shall be hereafter announced, and payment thereof will become due after the close of the irrigation season. The operation and maintenance charge for the irrigation season of 1916 will be due March 1, 1917. The method of determining the amount chargeable for operation and maintenance and the penalties for failure to pay the construction charges and the operation and maintenance charges when due are prescribed by act of Congress of August 13, 1914 (38 Stat., 686).

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, JANUARY 17, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supple-

mental thereto, and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, public notice was given February 26, 1915, that for all lands under the Truckee-Carson project, Nevada, the operation and maintenance charge for any irrigation season shall be due on March 1 of the following calendar year.

2. It was also announced that for the season of 1915 each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of 90 cents, which will permit delivery of not more than 1 acre-foot per acre, and should further quantities be needed they will be furnished at the rate of 10 cents per acre-foot.

3. Provisions of the said public notice are continued in effect for the irrigation season of 1916 and for subsequent years until further notice.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, FEBRUARY 11, 1916.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplementary thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water will be furnished from the Truckee-Carson project, Nevada, in the irrigation season of 1916 and each irrigation season thereafter upon the filing of proper water-right application for the irrigable lands shown on the following farm-unit plats, viz, Mount Diablo meridian, T. 18 N., R. 29 E.; T. 19 N., R. 29 E.; T. 19 N., R. 30 E.; T. 19 N., R. 31 E., approved January 28, 1916, by the Secretary of the Interior and on file in the office of the project manager, United States Reclamation Service, Fallon, Nev., and the local land office at Carson City, Nev.

2. Homestead entries of the farm units shown on said plats embracing public lands of the United States may be made on and after March 9, 1916, at 9 o'clock a. m., at the local land office, Carson City, Nev., if found regular and accompanied by the certificate of the project manager, showing that water-right application has been filed and proper water-right charges deposited.

3. Warning is hereby expressly given that no person will be permitted to gain or exercise any rights whatever under any settlement or occupation begun prior to 9 a. m. March 9, 1916, on any lands shown on said plats, provided, however, that this shall not interfere with any valid existing rights obtained by settlement or entry while the land was subject thereto. All persons desiring to acquire any public lands shown on said plats shall execute homestead application subject to the provisions of the reclamation act in the manner required by law, which with the required fees and commissions accompanied by certificate of the project manager as to the filing of water-right application and payment of water-right charges as hereinafter provided, shall be presented to the local land office at Carson City, Nev.,

in person, by mail, or otherwise, within a period of five days prior to March 9, 1916, that is, beginning not earlier than March 4, 1916. All entries filed as herein provided and reaching the local land office not later than 9 a. m., March 9, 1916, shall be held and treated as simultaneously filed. Applications presented after that hour will be received and noted in the order of filing. Any application not based on a prior settlement right will be subject to valid settlement claims asserted in the manner required by law.

4. The register and receiver will carefully compare all applications simultaneously filed as aforesaid and will dispose of them as follows:

(*a*) Where there is no conflict the application shall be allowed, irrespective of whether settlement is alleged.

(*b*) In case of conflicting applications and only one of the applicants alleges prior settlement, his application shall be allowed and the others rejected.

(*c*) If two or more conflicting applications are received, each containing allegations of prior settlement, a hearing shall be ordered to determine the priority of right, and it shall be restricted to those alleging such right.

5. Where there are applications conflicting in whole or in part in which no one of the several applicants claims prior settlement the register and receiver will write on cards the names of the several applicants, and each of these cards shall be placed in an envelope upon which there is no distinctive or identifying mark, and at 2 o'clock p. m. on the date of opening to entry, if practicable (if not, at the same hour one week later), after all the envelopes containing the names of the several applicants shall have been thoroughly mixed in the presence of such persons as may desire to be present, they shall be drawn and numbered in order. The cards as numbered and drawn will be securely fastened to the applications of the respective persons, and the applications shall be allowed in such order. Where any applicant fails to obtain land applied for by him he will be permitted to elect whether he will amend his application to embrace other lands not affected by pending applications and otherwise subject thereto when such amended application is presented, or withdraw his original application without prejudice, and in the event of such withdrawal the fees and commissions will be returned by the receiver, and the water-right charges deposited will be returned by the project manager. Applications conflicting in whole with those previously allowed will be rejected in the usual manner.

6. The project manager will receive water-right applications accompanied by the proper water-right payments which for the first payment from the homestead entrymen under paragraphs 3, 4, and 5, hereof, will be accepted in the form of New York draft or money order payable to the special fiscal agent, United States Reclamation Service, Fallon, Nev., or in currency, and issue certificates to applicants for public lands at any time after the date of this notice. Each application must be for a specific farm unit. More than one person may make water-right application for the same farm unit. Filing of water-right application and issuance of certificate gives no preference

right to make entry. Acceptance of application will be indorsed thereon by the project manager when notified by the local land office that entry has been allowed. All other applications, with payments made, will be returned to applicants upon surrender by them of the certificate of filing issued by the project manager.

7. The limit of area per entry representing the acreage which, in the opinion of the Secretary of the Interior, may be reasonably required for the support of a family upon such lands is fixed at the amounts shown upon the plats for the several farm units. The maximum limit of area for which water-right application may be made for lands in private ownership shall be 160 acres of irrigable land for each landowner. Water-right applications for lands in private ownership may be made on and after the date of this notice. All water-right applications whether for public or private lands must be made to the project manager, United States Reclamation Service, Fallon, Nev.

8. The water-right charges per acre of irrigable land are of two kinds:

(*a*) A charge of $60 per acre of irrigable land for the building of the irrigation system, payable as hereinafter provided; and

(*b*) An annual charge for operation and maintenance payable on March 1, of each year for the preceding irrigation season, and shall be the same as announced for the remaining lands of the project.

9. For homestead entries made after August 13, 1914, and for all lands in private ownership on initial payment of 5 per cent or $3 per irrigable acre on account of the construction charge shall be made at the time of entry or filing of water-right application, which application must be on the form provided under the reclamation extension act. The remainder of the construction charge shall be paid in annual installments, the first five of which shall be 5 per cent or $3 per irrigable acre each, and the remainder each 7 per cent or $4.20 per irrigable acre. The first of said annual installments shall become due and payable December 1 of the fifth calendar year after the initial installments and subsequent installments shall become due on December 1 of each calendar year thereafter.

10. In all cases where water-right application for lands in private ownership or for lands under entries not subject to the reclamation act shall not be made within one year after the date of this notice, the construction charge for such land shall be increased 5 per cent each year until such application is made and initial installment is paid.

11. Any water-right applicant or entryman may if he so elects pay the whole or any part of the construction charges owing by him within any shorter period than that provided by the public notices and orders applicable to his land.

12. All water-right charges must be paid to the proper officer of the United States Reclamation Service at Fallon, Nev., in cash, or by New York draft, money order or check.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in Appendix, p. 719.]

Feature costs of Truckee-Carson project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination		$226,857.52
Storage system:		
Lake Tahoe Reservoir	$158,752.43	
Lahontan Dam and Reservoir	1,454,909.72	1,613,662.15
Canal system:		
Main canals	448,616.00	
Lower Carson diversion dam	91,724.53	
Power house drop V line	62,487.63	
Main Truckee canal	1,583,810.32	
Truckee concrete chute	29,095.60	
Lahontan bench unit, section 1	20,584.29	2,236,318.37
Lateral system:		
District No. 1	176,239.85	
District No. 2	126,049.00	
District No. 3	300,977.83	
District No. 4	110,604.13	
District No. 5	282,725.00	
District No. 7	86,410.40	
Priming laterals (1905 and 1906)	48,888.18	1,131,894.39
Drainage system:		
District No. 1	141,002.04	
District No. 2	22,092.06	
District No. 3	36,512.17	
District No. 4	5,637.30	
District No. 5	44,287.70	
Drainage investigations	3,517.90	
Carson Lake drain	3,707.85	
Inman Mill right	8,038.46	
Deep drainage system	31,397.75	296,193.23
Flood protection, Carson River channel		131,821.37
Power system:		
Lahontan power plant	122,446.80	
Commercial power system	26,346.65	148,793.45
Farm units		17,280.11
Permanent improvements and land:		
Experimental farm	7,008.44	
Headquarters buildings	13,858.86	
Ditch tenders' houses	18,108.73	
Land	62,900.22	101,876.25
Telephone system		42,147.95
Plant accounts		24,449.20
Operation and maintenance charges transferred to and compounded with construction charges		2,022.93
Gross cost of construction of project to June 30, 1916		5,973,316.92
Less revenues earned during construction period:		
Rental of buildings	17,684.11	
Rental of grazing and farming lands	17,919.82	
Contractors' freight refunds	412.07	
Forfeitures by defaulting bidders and contractors	499.95	
Profit on mess-house operations	17,756.13	
Profit on mercantile-store operations	17,825.35	
Loss on hospital operations	[1] 1,377.97	70,719.46
Amounts set up as reserves or depreciation charged to cost and not expended		22,608.05
Total		93,327.51
Net cost of construction of project to June 30, 1916		5,879,989.41

[1] Deduct.

Estimated cost of contemplated work, Truckee-Carson project, during fiscal year 1917.

Features.	Sub-feature.	Principal feature.
Examination and surveys		$12,000
Storage system, Lake Tahoe		18,000
Canal system:		
D line canal	$5,000	
Main Truckee canal	2,000	
		7,000
Lateral system		40,000
Drainage system		100,000
Farm units		5,000
Permanent improvements and land		10,000
Telephone system		1,000
Operation and maintenance under public notice		83,000
Messes		2,000
Hospitals		2,000
		280,000

NEW MEXICO, CARLSBAD PROJECT.

L. E. FOSTER, project manager, Carlsbad, N. Mex.

LOCATION.

County: Eddy.

Townships: 18 to 24 S., Rs. 25 to 29 E., New Mexico meridian.

Railroad: Atchison, Topeka & Santa Fe System.

Railroad stations and estimated population January 1, 1916: Carlsbad, 2,750; Otis, 25; Loving, 150; Malaga, 75.

WATER SUPPLY.

Source of water supply: Pecos River.

Area of drainage basin: 22,000 square miles.

Annual run-off in acre-feet of Pecos River at Carlsbad and Dayton (22,000 square miles) 1899 to 1915: Maximum, 912,000; minimum, 148,000; mean, 319,000.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916: 24,796 acres.

Area under water-right applications, season of 1916: 22,530 acres.

Length of irrigating season: From March to November and two weeks in winter, 260 days.

Average elevation of irrigable area: 3,100 feet above sea level.

Rainfall on irrigable area: 1901–1915, average, 14.9 inches; calendar year 1915, 18.63 inches.

Range of temperature on irrigable area: —5° to 110° F.

Character of soil of irrigable area: Pecos sandy loam with large lime content.

Principal products: Alfalfa, cotton, grain crops, melons, peaches, pears, and miscellaneous fruits.

Principal markets: Carlsbad, N. Mex.; Denver, Colo.; Chicago, Ill.; Kansas City, Mo.; Texas cities; New York, N. Y.

LANDS OPENED FOR IRRIGATION.

Dates of public notices: December 17, 1907; November 30, 1908; June 2 and November 17, 1909; October 7, 1910; March 3, 1911; February 17, 1912; March 2 and April 10, 1915; and February 24, 1916.

Location of lands opened: Ts. 21, 22, 23, and 24 S., Rs. 26, 27, 28, and 29 E., New Mexico meridian.

Irrigable lands opened: 24,796 acres; State lands 923 acres; private 23,707 acres; public 166 acres.

Duty of water: 3 acre-feet per acre per annum at the farm.

Building charge per acre of irrigable land: $31, $45, and $60 (public notice for lands at $55 not yet issued).

Annual operation and maintenance charge for 1915: Graduated scale according to use (1916 public notice): First acre-foot, $1.25; second acre-foot, 15 cents; third acre-foot, 25 cents; fourth acre-foot, 40 cents; fifth acre-foot, 60 cents; additional acre-feet, 75 cents per acre-foot.

CHRONOLOGICAL SUMMARY.

Reconnoissance made and preliminary surveys begun in 1904.

Construction recommended by board of engineers August 31, 1905.

Construction authorized by Secretary, February 24, 1906.

Construction completed at Avalon diversion 1912.
Canal system of Pecos Irrigation Co. purchased February, 1906.
First irrigation by Reclamation Service, season 1907.
Project 73 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Carlsbad project provides for the storage of water in Lake McMillan, on Pecos River, near Lakewood, N. Mex., and in a storage and distributing reservoir on the same river near Carlsbad, N. Mex., controlled by Avalon dam; and the diversion of water from Avalon Reservoir into a canal system, watering lands on both sides of Pecos River, in the vicinity of Carlsbad. The United States claims all waste, seepage, spring, and percolating water arising within the project and proposes to use such water in connection therewith.

The major construction features of the project were completed in 1912, the principal of which are: The Avalon Dam, which has a concrete core wall; McMillan, an earth and rock fill dam, which was built by private capital, antedating Government control; a concrete flume spanning the Pecos River, with 4 arches of 100 feet each; a reinforced concrete siphon, under Dark Canyon, 6 feet in diameter, originally 400 feet long, which was lengthened to 600 feet in 1916; about 50 miles of canals and laterals (exclusive of sublaterals and ditches); a concrete headgate structure at each of the dams, and two spillway tunnels driven through rock, each 21 feet in diameter, lined with concrete, aggregating 200 feet in length, equipped with heavy cylindrical gates operated by turbines (replacing concrete spillway equipped with wooden emergency gates, spillway having been closed with concrete); and a reinforced concrete circular spillway 393 feet long. All checkgates, spillways, and headgate structures on the canals and all turnouts on the laterals are of concrete construction.

SUMMARY OF GENERAL DATA FOR CARLSBAD PROJECT TO JUNE 30, 1916.

Areas:			
Irrigable acreage when project is complete			24, 796
Public land entered, June 30, 1916		166	
State land, June 30, 1916		923	
Private land, June 30, 1916		23, 707	
Acreage service could have supplied, season of 1915			24, 796
Estimated acreage service can supply July 1, 1917			24, 796
Acreage actually irrigated, season of 1915			13, 470
Acreage cropped under irrigation, season of 1915			11, 322
Crops:			
Value of irrigated crops, season of 1915			$245, 684
Value of irrigated crops per acre cropped			$21. 70
Finances:			
Estimated cost of completed project			$1, 464, 000
Total construction cost to June 30, 1916			$1, 065, 201. 85
Per cent complete, June 30, 1916			73
Appropriation for fiscal year 1917, total			$323, 000
Allotment for construction, fiscal year 1917			$254, 000
Estimated per cent complete, June 30, 1917			90
Announced construction charges per acre			$31, $45, $55, $60
Appropriation, fiscal year 1916			$128, 000
Expenditure during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$87, 978. 37		
Transfers	10, 605. 98		
		$98, 584. 35	
Registered liabilities chargeable to 1916 appropriation		14, 454. 53	
			$113, 038. 88
Unencumbered balance, July 1, 1916			14, 961. 12

Repayments:		
Construction charges—		
Accrued to June 30, 1916		$153, 501. 80
Collected to June 30, 1916		$141, 433. 74
Uncollected, June 30, 1916		$12, 068. 06
Operation and maintenance charges (public notice)—		
Accrued to June 30, 1916		$152, 788. 91
Collected to June 30, 1916		$140, 530. 54
Uncollected, June 30, 1916		$12, 258. 37
Drainage:		
Estimated acreage damaged by seepage to June 30, 1916		3, 000
Drains built to June 30, 1916—		
Open ... feet	11, 890	
Closed ... do	19, 910	
Total		31, 800
Estimated acreage protected by drains built to June 30, 1916		870
Estimated acreage to be protected by authorized system		5, 200
Expended, to June 30, 1916, on drainage works, completed and uncompleted		$57, 871. 66

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

ORIGIN OF PROJECT.

The Carlsbad project had its inception in a private enterprise begun in 1888, when a small diversion dam was built on Pecos River, near the present site of the Avalon Dam, to divert water for the irrigation of lands near La Huerta, about 6 miles from Carlsbad. This irrigation system was enlarged and storage facilities in lakes McMillan and Avalon were provided, so that in 1904 about 13,000 acres of land were irrigated. In October, 1904, however, an unusual flood carried away the dam at Avalon and greatly damaged the distribution system then in use. The Pecos Irrigation Co., which controlled the system at that time, was unable to repair the damage in a satisfactory manner and place the delivery of water on a permanent basis. The construction of temporary works was begun, but they were carried away by floods, and the Government was requested to acquire the rights of this company and establish a permanent irrigation system that would be satisfactory to the settlers.

A consulting board, consisting of Messrs. W. H. Sanders, G. Y. Wisner, Morris Bien, B. M. Hall, and W. M. Reed, met at Carlsbad on August 28, 1905, and after consideration of the conditions on the project recommended that $600,000 of the reclamation fund be allotted for the purchase and repair of the system of the Pecos Irrigation Co., $150,000 being specified as the purchase price. It was further recommended that all construction, except the rebuilding of Avalon Dam, should be done by Government forces. The recommendations of the board were approved by the Secretary of the Interior on November 28, 1905. The Pecos Irrigation Co. agreed to accept $150,000 for its rights and property, and after title was examined and perfected, construction of the project was authorized by the Secretary of the Interior February 24, 1906.

The work found to be necessary to make the project a success consisted of the following: The construction of the east embankment of McMillan Reservoir to separate the reservoir from the cavernous gypsum formation along the east shore; the reconstruction of the west embankment and a new head-gate structure; rebuilding the Avalon Dam as a substantial structure, with a core wall extending to bed-rock; the construction of new controlling works at spillway No. 1; and a new head-gate structure; the reconstruction and repairing of the entire system of canals and laterals, installing new head gates, storm gates, and lateral gates of reinforced concrete for the canal system; repairing the concrete aqueduct across the Pecos River; building the reinforced-concrete inverted-syphon across Dark Canyon; and reconstructing the Black River Canal. The Black River Canal forms a separate system and takes water by direct diversion from Black River.

M'MILLAN RESERVOIR.

The main storage reservoir of the Pecos Irrigation Co. was Lake McMillan. The works were constructed in 1893–94. The reservoir was formed by a dam 1,686 feet long and 52 feet high across the channel of the Pecos River, and the west embankment, 5,200 feet long with a maximum height of 18.8 feet, was built across low ground 1½ miles west of the main dam.

During a period of extreme high water, on June 15, 1894, the face of the main dam showed a settlement that seemed very dangerous, and an emergency spillway was made in the west embankment. Later the section was reduced to the natural ground surface, thereby doing away with the storage that was due to a mile of embankment. This channel was used as a spillway for 10 years, the water returning to the river channel two miles below. The channel was in earth, and during flood in June, 1903, the cut back was extended nearly to the reservoir rim, making it absolutely necessary to close the spillway. This was accomplished during the winter of 1903–4 by rebuilding this portion of the west embankment. Spillway No. 2 was built at this time through a limestone and conglomerate formation located at the southeast end of the west embankment.

On October 2, 1904, extreme high water again threatened the main dam, and a breach was made through the new portion of the west embankment by explosives. During the flood about 80,000 cubic feet per second was discharged through this opening and the other spillways. The break or washout was about 1,600 feet long.

From September, 1908, to January, 1909, the outlet works and the west embankment were reconstructed. The east embankment was also constructed at this time.

The new head-gate structure is of reinforced concrete, and is provided with five 4 by 8 foot openings. The gates installed at this time were of timber and are operated from above by a 6-horsepower gasoline engine.

The west embankment was repaired by contract. The repaired portion was 1,600 feet long, with a crest width of 6 feet and top elevation of 3,266.6, or 10 feet below the remainder of the embankment; this was built low to provide for an emergency spillway.

The east embankment was constructed by Government forces. This embankment is 4,000 feet long and originally had a crest width of 8 feet at elevation 3,268.5, a maximum height of 19 feet, back slope of 1½ to 1 and a water slope of 2 to 1, riprapped 2 feet thick.

The flood of July, 1911, overtopped the low portion of the west embankment, which had purposely been left low, and caused a break about 600 feet long; the east embankment was also overtopped and some damage done to the rear slope.

The old spillway channel had cut back nearly to the west embankment, making it necessary to avoid further spillage at this point. The break was permanently closed during 1911–12 and brought up to the same elevation as the remainder of the embankment, 3,276.6, and a new spillway provided farther north by removing part of the old embankment and protecting the end thereof by heavy riprap and a training dike 1,300 feet long to deflect spilled water away from the rear of the embankment. The east embankment was also rebuilt. The crest was widened to 12 feet and the height increased from elevation 3,268.5 to 3,273. The height of the main dam was also increased from 3,276.6 to 3,280 at this time.

Capacity surveys, McMillan Reservoir.—The silt survey of 1904 was made by the United States Geological Survey at a time when the reservoir was empty. The survey was accomplished by taking borings 300 feet apart on a series of parallel lines located at intervals of one-fourth mile. The actual depth of the silt deposits was measured, and the location of the original ground surface was determined by the change in the character of the material or the presence of vegetable matter.

The survey of 1911 was also made at a time when the reservoir was empty. This was a transit and stadia survey; a topographical map was made and the actual capacity was worked out by measuring the areas included by the various contours.

The survey of May, 1915, was made with the reservoir full of water. The survey of the submerged portion was made from a motor boat, which was run on a series of parallel lines located at intervals of 330 feet. The motor boat was kept on line by signalmen on either shore, and located at frequent intervals by observing "cut-in" signals with a sextant. Soundings were taken at intervals of one-half minute, or about 300 feet. The northern end of the reservoir was sufficiently silted up to permit of the topography being taken with transit and stadia. A topographical map was made and the capacity of the reservoir computed therefrom.

Capacities and areas submerged, McMillan Reservoir.

Date.	Elevation of flow line.	Capacity.	Area submerged.
		Acre-feet.	*Acres.*
1891[1]	3,266.6	82,644	8,331
August, 1904	3,266.6	62,000	7,100
November, 1910	3,266.6	44,000	....
May, 1915	3,266.6	38,500	5,500
Do	3,268.6	51,500	7,860

[1] Original survey was made in 1891 and the reservoir was first used in 1894. Present flow line is at elevation 3,268.6 and flood line at 3,272.6.

The above table indicates a total loss in capacity of 64 per cent in a period of 21 years, or an average annual rate of silting of 2.6 per cent. It is doubtful, however, if the annual rate of silting can be determined even approximately, as it has been demonstrated that one flood of several days' duration will carry and deposit as much silt as several years of normal flow.

Reservoir losses.—A study of the leakage from Lake McMillan through strata of gypsum, was made by Mr. W. M. Reed during 1904.

In June, 1916, a study was made of the losses by seepage and evaporation from the McMillan and Avalon Reservoirs, with a view of determining the amount of McMillan seepage intercepted at Avalon. The study is based on the monthly storage records, the river flow as measured at the Dayton gaging station above McMillan, the evaporation from both reservoirs, and the canal draft. Months during which the quantities were affected by side inflow or spillage at either reservoir were omitted. The average annual seepage loss from the McMillan Reservoir for the years 1912, 1913, 1914, and 1915 is about 140,000 acre-feet. The study shows the average annual inflow into the Avalon Reservoir from this source to be about 100,000 acre-feet, or a continuous flow of about 140 cubic feet per second. The difference of 40,000 acre-feet represents the total seepage losses in the reservoir system. The average annual flow of the Pecos River and tributaries above the McMillan Reservoir for the above years, deducting evaporation, is about 342,500 acre-feet. By dividing the average annual seepage loss in both reservoirs by this amount the loss by seepage is shown to be about 12 per cent of the river flow.

The conclusions arrived at in the study are borne out by a series of meter measurements taken above Avalon during periods when the flow was not affected by side inflow or spillage.

The early heavy seepage losses through a cavernous gypsum formation along the east shore of the McMillan Reservoir have been largely cut off by the east embankment. There still remains a long stretch of the gypsum formation along the upper east shore of the reservoir. It is probable that most of the present seepage is through this formation. The seepage losses in the Avalon Reservoir are, as far as known, small. The formation is limestone in regular and close-fitting layers and not liable to seepage.

AVALON DAM.

The first Avalon Dam was built by the Pecos Irrigation & Development Co. near the site of the present dam during the winter of 1889–90. This was a rock-fill dam, with a blanket of earth on the water slope. The maximum height was 46 feet. This dam was completely destroyed on August 5, 1893.

The new dam was constructed during the winter of 1893–94. The new structure was 1,380 feet long, with a maximum height of 50 feet.

The flood of 1904, which made it necessary to provide an emergency spillway for the McMillan Reservoir by dynamiting the west embankment, caused a breach 450 feet long at the highest point of the Avalon Dam and totally destroyed and swept away the timber head-gate structure and the controlling works of spillway No. 1.

Present Avalon Dam.—The present Avalon Dam was built on the site of the old dam at the head of the main canal, 6 miles above Carlsbad, a portion of the old dam being utilized in the new structure. In March, 1906, specifications for the construction of this dam were prepared and advertisement issued inviting proposals. No proposals, however, were received, and on April 18 authority was granted for the construction of this feature by Government forces. Preparatory work was begun at the dam May 1, and actual construction was commenced June 1, 1906, and completed in November, 1907. A change in design was made after construction was begun, a concrete core wall to bedrock being substituted for steel sheet piling on the west bank of the river, where bowlders prevented the satisfactory placing of the piling. The Avalon Dam is an earth and rock fill structure 50 feet in height above river bed and 1,380 feet long. The width across the top is 43 feet. The reinforced concrete head-gate structure for the canal outlet was built in 1907.

The following new construction work was done by Government forces from September, 1911, to June, 1912, in accordance with recommendations contained in Board of Engineers report of December 7, 1911:

Spillway No. 1.—No. 1 spillway was abandoned as a controlled spillway and rebuilt to form an overflow spillway. The old walk above the gates was removed, and the 39 spaces between the concrete piers, which were formerly occupied by the emergency gates, were walled up with reinforced concrete slabs 13 inches thick. The crest of the new spillway is 233 feet long and at elevation 3,178.

In the fore bay above spillway No. 1 two vertical cylinder gates 8 feet high and 21 feet in diameter were installed. The gates are 78 feet apart and a steel footbridge connects them with the canal head-gate structure. Each gate is set between three concrete piers and is held in place by guides anchored into the piers and runners riveted to the gates. The operating platforms are built on top of the piers, about 20 feet above the gate seats. The lifting machinery is operated by a small water turbine, one for each gate, set in a chamber between the walls of spillway No. 1 and the nearest pier; counterweights at each pier assist in operating the gates. Water is discharged through two tunnels, one of which is 97 feet long and the other 103 feet long. The tunnels are lined with reinforced concrete and are vertical at the gate seats, changing to horizontal about 20 feet below; the minimum cross-sectional area of each is 227 square feet.

Spillway No. 2.—A concrete overflow dam was built at spillway No. 2. The dam is of two distinct types, separated by a pier near the middle. The part east of the division pier is a gravity dam; the west portion is composed of a cut-off wall 5 feet thick to bedrock, and is protected by two concrete steps with treads 9 and 10 feet long and risers 7.5 feet high. A concrete apron 30 feet long was built below the lower toe of the dam. The dam forms an overflow spillway, with a crest length of 393 feet at elevation 3,178, and conforms to the circumference of a circle of 250 feet radius; it contains 5,521 cubic yards of concrete.

The height of the dam and the concrete head wall at the east end was increased from elevation 3,188 to 3,192. An earth dike was built on top of the dam and the water slope faced with a thin layer or reinforced concrete tied to the core wall with grouted bars.

The concrete wall at the lower toe of the dam was extended, and a blanket of concrete placed on the cap rock below spillway No. 1.

DISTRIBUTION SYSTEM.

Shortly after the purchase of the project by the United States Reclamation Service, surveys were made of the main canal and lateral system.

The canal was very irregular in section and profile, and was not provided with an upper bank, the water surface varying in width from 50 to 1,000 feet.

The concrete flume or aqueduct crossing the Pecos River was built in 1903 by the Pecos Irrigation Co. at a cost of $52,053.82. The material on which the piers are founded is a poor grade of limestone. The footing area of the piers was 8 by 25 feet, and under full load the pressure was about 16 tons per square foot. The normal pressure and that exerted by the flood of October 2, 1904, caused the three river piers to sink bodily from 0.2 to 0.6 of a foot, throwing the structure out of shape and causing large cracks in the superstructure.

The water in the old canal was carried across Dark Canyon in a large shallow lake that was formed by an earth embankment at the lower end of the canyon. Dark Canyon is usually dry, but is subject to occasional large floods. The spillways and the greater portion of the embankment were destroyed during a large flood in October, 1904.

The work of rebuilding the main canal and installing new lateral head-gate structures of reinforced concrete, repairing the concrete flume across the Pecos River, and constructing the Dark Canyon siphon was done by Government forces from April, 1906, to October, 1908.

The main canal was regraded and a new upper bank built throughout and six overflow spillways of concrete were built in the lower bank to relieve the canal of flood waters. A large amount of repair work was done on the lateral system, 30 new lateral head gates of concrete were constructed, and a great many wooden farm head gates, checks, and division boxes were replaced with concrete.

Canal lining.—About 8 miles of the main canal at the extreme southern end of the project are located through a gypsum district, where the formation is bedded gypsum sand interstratified with layers of gypsum ledges. The water losses in this stretch have been unduly large, both prior to and during the time the Reclamation Service has been operating the project, and considerable damage has been caused to lands lying adjacent to the canal.

From 1912 to 1915, 7.2 miles of the southern end of the canal were lined with concrete. The base width of the lined section varies from 10 to 12 feet; the thickness of the lining is 0.2 of a foot and the height 4 feet, with an allowance of 6 inches for free-board; the side slopes are 1½ to 1.

The earth canal section had to be narrowed from an average bottom width of 15 feet to 10 and 12 feet. The earth forming the side slopes was well compacted before the final trimming was begun. About one-half of the final trimming was done with shovels and the remainder with a large trimming knife, which was slid and worked down the slope on 1¼-inch T irons previously set true to slope and at intervals of 10 feet by the template crew. The trimming knife consisted of a steel blade 12 feet long, well braced to prevent bending and was equipped with three pipe handles so arranged that the tool could be operated easily from the canal banks by a crew of six men. The use of this tool resulted in a considerable saving.

Gravel was hauled from Black River, a distance of about 8 miles, and cement from Loving, about 3 miles. Two Smith mixers were used; these were of 6 cubic feet capacity and were operated by gasoline engines. The mixer was moved 200 feet at a time to gravel piles previously placed. Concrete was dumped through chutes on the canal bottom and hauled in wheel barrows a maximum distance of 100 feet each way. Forms for the side slopes consisted of open squares 5 feet long, with a height and thickness equal to that of the finished lining. Concrete was placed on the slopes first; this was a dry mix and was well tamped as it was placed. The bottom was placed last; this was a comparatively wet mix. All concrete was hand finished with steel trowels.

Expansion joints three-eighths of an inch wide consisting of a special felt material with asphaltum filler placed at intervals of 50 feet were used on about one-third of. the lining. Cracks, occurring at intervals of about 25 feet, extend across the section, with a few additional cracks on the side slopes. The cracks occur at about the same intervals on all the lining, except that on the section where expansion joints were used the cracks extending across the section usually occur at the joints. Practically all of the cracks are small and hardly discernible during the irrigation season.

Repair of flume.—The concrete flume across the Pecos River was repaired as follows: The footing area of the three river piers was increased from 8 by 25 feet to 16 by 25 feet. This was accomplished by widening the piers 4 feet on each side, the concrete extending from bedrock to the arch ring. A rupture in the arch ring was repaired and the flume lengthened 25 feet at each end; in addition a curtain wall of concrete extending to bedrock was built at each end to prevent the washing out of the adjoining fills.

Dark Canyon siphon.—The Dark Canyon siphon is of reinforced concrete, 6 feet in diameter and 400 feet long. The maximum pressure head is 20.5 feet and a blow-off valve was placed at the low point. The head utilized by the siphon, 2.6 feet, was obtained by regrading the canal and concentrating the surplus fall at this point. The canal banks at both ends of the siphon are carried around the head walls and riprapped to prevent cutting.

Black River Canal System.—The Black River Canal system, as formerly operated by the Pecos Irrigation Co., was supplied directly by the main canal, which was carried across Black River by means of a timber flume. The flume rotted away early in the history of the project and has never been replaced. Instead a low concrete dam about 70 feet long and from 2 to 4 feet high has been built across the river about one-half mile below the flume, and from this a new canal about 3 miles long has been constructed, joining one of the larger laterals from the old canal on higher ground. The water from the old canal was dropped into the river at the old flume crossing and taken out by the new canal. About 9 second-feet of water obtained from Black River are thus rendered available in addition to the amount carried by the main canal. As far as can be ascertained, the main canal south of Black River has been used very little, if at all.

The Black River Canal was reconstructed by the United States Reclamation Service; the work was begun in March, 1906, and completed two months later, water being delivered on May 22, 1906. About 6 miles of canal were reconstructed and a concrete lining was placed in the canal for 4,000 feet below the heading.

The main canal for the 5 miles immediately north of Black River is through an extremely leaky gypsum formation. The new Black River supply ditch taps the main canal about 3½ miles north of Black River, and, following a more direct and favorable location than the old canal, discharges into Black River immediately above the dam. The new supply ditch was built from May, 1907, to February, 1908. The first 11,640 feet are through a gypsum formation and are lined with concrete; better material is then reached and 7,043 feet are in earth section. The drop into Black River is made through a concrete-lined section 290 feet long.

The original capacity of the Black River supply ditch was about 20 second-feet. From August to October, 1909, the capacity of the ditch was increased to 40 second-feet. This was accomplished by increasing the height of the concrete lining and enlarging the earth section.

BOARD MEETINGS.

Board meetings affecting construction on the Carlsbad project since its inception, with dates and personnel, are as follows:

December 15, 1904, B. M. Hall and W. M. Reed, preliminary report on the condition of the project.

February 16, 1905, W. H. Sanders, B. M. Hall, and W. M. Reed, preliminary report.

August 31, 1905, W. H. Sanders, George Y. Wisner, Morris Bien, B. M. Hall, and W. M. Reed, report recommended that $600,000 of the reclamation fund be allotted for the purchase and repair of the system of the Pecos Irrigation Co., $150,000 being specified as the purchase price.

December 7, 1911, D. C. Henny and Louis C. Hill, report on flood damage Avalon Reservoir; also recommendations concerning construction of cylindrical gates and circular spillway No. 2.

September 5, 1914, D. W. Murphy, L. E. Foster, W. B. Wilson, and Scott Etter, admission of lands under second unit and recommendations for canal lining and drainage works.

June 11, 1915, D. C. Henny, Louis C. Hill, and E. H. Baldwin, flood damages McMillan Reservoir and distributing system; recommendations concerning McMillan spillways and extension to Dark Canyon siphon.

May 3, 1916, F. E. Weymouth, D. C. Henny, R. F. Walter, and L. E. Foster, Pecos River water supply, silt studies, and McMillan spillways.

CONSTRUCTION DURING FISCAL YEAR.

McMillan Reservoir.—On April 18, 1915, a large flood on the Pecos River overtopped the east embankment of the McMillan Reservoir, causing several breaks and badly eroding the outer slope. The channel of the new No. 3 spillway around the north end of the west embankment was badly eroded to within the reservoir rim, making it necessary to permanently close it. The east embankment was rebuilt and repaired. This required the placing of 19,650 cubic yards of earth and 3,050 cubic yards of riprap. The west embankment was extended 2,400 feet and spillway No. 3 permanently closed; 15,809 cubic yards of earth and 1,211 cubic yards of riprap were placed. The five wooden headgates at the McMillan Reservoir were replaced with cast-iron gates. On account of the necessity of installing the new gates and passing the river in a space only 34 feet wide, considerable difficulty was experienced on this work. Surveys and investigations to increase the spillway capacities of the McMillan Reservoir were begun.

Distributing system.—On April 16, 1915, a flood occurred in Dark Canyon and Hackberry Draw, the peak of the run-off being estimated at 40,000 to 50,000 second-feet. The water from the two sources overtopped portions of the canal banks and caused considerable damage. The outlet structure of the Dark Canyon siphon and about 75 feet of the connecting canal were destroyed. The Santa Fe Railroad bridge crossing Dark Canyon, below the siphon, was also washed out at this time.

The discharge area of Dark Canyon was increased by extending the siphon 200 feet. The work involved the excavation of 1,550 cubic yards of rock and indurated material, 3,487 cubic yards of backfill, and the placing of 240 cubic yards of concrete, 15,394 pounds of steel reenforcement, and 324 square yards of paving. The siphon is now 600 feet long; the extension is of the same general dimensions as the older portion, except at the outlet end where the last 40 feet is a transition section, changing from 6 feet circular to 9 feet square. The siphon was originally built in 1906; samples taken in 1916 showed an excellent quality of concrete.

Lateral and farm headgates were built to serve the lands admitted under the second unit; in addition a reenforced concrete siphon crossing the Pecos River about 1½ miles below the Avalon Reservoir and 155 linear feet of No. 96 Hess flume were constructed to serve new lands west of the river. The barrel of the siphon is 875 feet long and is 21 inches square on the inside, with corner shoulders of 4 square inches. The maximum pressure head is 28.5 feet, the friction and velocity heads 3.15 feet, and the capacity 11 cubic feet per second. The banks of the river where the siphon crosses are steep and composed of a light soil, so that deep cuts were necessary. The river bottom is composed of gravel. In building the siphon considerable pumping was necessary; 4,216 cubic yards of material were excavated, 3,945 cubic yards backfilled, and 296 cubic yards of concrete and 21,566 pounds of steel reenforcement placed.

The Black River Canal was lined with concrete 0.2 of a foot thick for a distance of 12,650 feet. The first 1,600 feet have a base width of 6 feet, and the remainder a base width of 3 feet. The methods of construction were, in general, similar to those used in lining the main canal; 6,068 cubic yards of material were excavated, and 19,074 square yards of concrete placed.

About 4,000 feet of the upper portion of the Black River Canal were lined with concrete in 1906. During the last few years this stretch has given considerable trouble, and the lining has failed in many places. About 1,785 feet of the more troublesome portion have been lined with Hess metal flume No. 108. The flume is supported on timber carriers 10 feet long and 4 inches square, the ends of which are supported on low concrete pedestals; 7,510 board feet of timber and 66 cubic yards of concrete were placed.

Drainage system.—Open drainage ditches and tile drains were constructed as follows: Open drain D, 6,825 feet long; average depth, 10.5 feet; excavation, class No. 1, 43,965 cubic yards; class No. 3, 4,901 cubic yards. Open drain B, to June 30, 1916, 5,075 linear feet; average depth, 10.5 feet; excavation, class No. 1, 34,435 cubic yards; not completed. Closed drain D-1, average depth, 9 feet; 3,750 feet of 15-inch tile; 660 feet of 12-inch tile; excavation, 5,471 cubic yards; back fill, 6,228 cubic yards. Drain D-1 begins at the upper end of open drain D. The material in the closed drain was excavated with a size 00 Austin trenching machine, operated by a 36-horsepower gasoline engine; backfilling was done by teams.

A Monigan drag-line excavator, with a capacity of 1 cubic yard, which was operated by a 45-horsepower gasoline engine, was used on the open drains.

SEEPAGE AND DRAINAGE.

Losses in about 7 miles at the lower end of the southern canal have been reduced to a minimum as a result of lining the section with concrete. It was determined by careful measurements in this stretch of canal that the loss was negligible. The loss in the sections through gravel, conglomerate, and earth were apparently about the same as in former years. The losses in the lateral system are large.

Seepage conditions in the gypsum area around the town of Loving are much improved over last season by reason of the completion of about 7 miles of canal lining. A considerable acreage along the main canal, which was badly seeped and totally unfit for crops, is greatly improved in condition and a part of it was under crop this season. It is hoped that the concreting of two leaky laterals in this district will reduce greatly the amount of drainage estimated for the area. Open drain D, dug through an area 3 miles east of Loving, has resulted in lowering the water table several feet; and the completion of closed drain D-1, which has been built to drain a small area beyond the influence of this open drain, will afford adequate protection for several hundred acres of seeped land in that area. In the Otis area, where two tile drains have already been constructed, the need for additional drainage has been apparent for some time. In this district open drain B is under construction. In a small area east of Otis the water table has risen rapidly during the season of 1916. Studies to determine the elevation of ground water and the location for a drain have been completed in this area. On account of seepage 513 acres of land have been suspended from time to time from the payment of water-right charges. Two hundred and eighty acres of this land were restored for payments in June, 1916.

ECONOMIES OF GOVERNMENT WORK.

From time to time advertisements inviting bids on various features of the work have been issued. Bids were received on only two features, as follows: For the reconstruction of the west embankment of the McMillan Reservoir in 1909 and for the reconstruction of the same embankment in 1911. The work in 1909 was done by contract. Two bids were received for the additional work in 1911; the bids were considered too high and were rejected. The work was done by Government forces and resulted in a considerable saving, as shown below.

Estimated saving, construction by Government forces.

McMillan Reservoir, earthwork, west embankment, and trenching under embankment:	
Cost of work by Government forces	$8,058.35
Estimated cost if lowest bid had been accepted	10,520.00
Estimated saving in cost	2,461.65

OPERATION AND MAINTENANCE.

Water was turned out of the canals on the project for the season of 1915 on November 8. A winter irrigation for small grains was made in late January and early February, 1916. The regular irrigation season began on March 15, 1916.

The run-off of the Pecos River was large during the early season and until June 1, 1916, by reason of a large snowfall and a late spring upon the headwaters of the Pecos watershed. On account of practically no rainfall on the project during the spring and summer, the demand for water on the farms was large.

Maintenance during the winter and spring of 1916 consisted mainly of weed cleaning on the lateral system and dragging moss from the main canal.

The total acreage in crops to June 30, 1916, amounted to about 15,600 acres. The area irrigated during the season of 1915 amounted to 13,470 acres.

Historical review, Carlsbad project.

Item.	1910	1911	1912	1913	1914	1915
Acreage for which service was prepared to supply water	20,267	20,267	20,277	20,261	20,261	24,796
Acreage irrigated	13,203	14,853	13,509	14,260	12,740	13,470
Miles of canal operated	45	45	45	45	45	45
Water diverted (acre-feet)	93,361	85,100	85,086	86,560	87,900	79,530
Water delivered to land (acre-feet)	31,561	33,198	38,764	33,044	30,900	28,857
Per acre of land irrigated (acre-feet)	2.40	2.20	2.90	2.30	2.40	2.14

SETTLEMENT.

Settlement has been almost at a standstill and development on many farms has been slow. Those farms owned by nonresidents are operated largely by tenants and show only small improvement. The development on many farms operated by owners has been marked and shows large improvement.

Two cooperative organizations on the project (the Otis Creamery and the Otis Union) were active during the year. The output of butter was small, but a good qualilty was produced; it was marketed locally. The growth of the principal town on the project was normal.

A State armory located at Carlsbad, to cost $18,000, was nearing completion at the end of June.

Settlement data, Carlsbad project.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	[1] 521	519	524	616	594
Population	675	940	950	950	912
Number of irrigated farms	345	362	362	390	325
Operated by owners or managers	145	224	240	280	149
Operated by tenants	[2] 200	138	122	110	176
Population	650	910	926	541	912
Number of towns	4	4	4	4	4
Population	3,000	3,100	3,200	3,000	3,000
Total population in towns and on farms	3,675	4,040	4,150	3,950	3,912
Number of public schools	7	7	7	7	7
Number of churches	8	8	8	8	8
Number of banks	2	2	2	2	2
Total capital stock	$80,000	$80,000	$80,000	$80,000	$80,000
Total amount of deposits	....	....	$547,000	$687,000	$737,000
Total number of depositors	....	....	1,400	1,484	1,694

[1] Water-right applicants.

[2] In 1912 many farms were operated by 1 man. The 200 farms were actually operated by 28 tenants.

PRINCIPAL CROPS.

The cropped area during 1915 amounted to 11,322 acres. The principal crop from the acreage standpoint was alfalfa. The yield of hay was 0.4 ton lower than in 1914, probably due to the fact that a considerable acreage was devoted to growing seed. The additional value of seed made the total value of the alfalfa crop about equal to that of the previous season. The largest per-acre value for any field crop was for cotton, which averaged about $49 per acre for 456 acres. The small acreage of cotton was due to the low prices of 1914. The average yield for cotton exceeded that for former seasons by about one-fourth of a bale per acre. The orchards barely paid the picking and packing expenses, and the industry as a whole did not pay expenses. The acreage in the sorghum head-corns and Indian corn was small, and the per-acre value was small. The total area in crops exceeded that of 1914 by 501 acres, not including the fall acreage of grain and new alfalfa. The average value of all crops was 45 cents per acre less than in 1914, and the total value was about $8,000 more than for the previous year.

The census of live stock shows a very marked increase in the number of stock on the farms. The number of live stock on the farms January 1, 1915, was 1,881, and on December 31, 1915, the number amounted to 12,644. The large increase was due to the large number of cattle and sheep being fattened on the project, although the increase in hogs alone amounted to 270 per cent. The increase in dairy cattle was about 50 per cent.

About 2,300 acres of small grain were harvested in June, 1916. The yield was somewhat below normal, probably due to a dry and windy winter and spring. A large acreage was planted to cotton in 1916, and the crop was in good condition at the end of June. A large acreage of alfalfa was left for seed, and the prospects for an average yield were good. The peach crop, due to ripen in August, is small, on account of late killing frosts which occurred in April.

Crop report, Carlsbad project, New Mexico, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa hay	7,499	Tons	15,407	2.1	$8.29	$127,757	$17.04
Alfalfa seed	2,070	Pounds	280,775	136	.13	38,082	18.40
Barley	60	Bushels	1,190	19	.95	1,140	19.00
Beans	56	Pounds	15,280	272	.08	529	9.45
Beets, sugar	7	Tons	35	5	4.85	170	24.29
Cane	339	...do	982	3	5.02	4,930	14.54
Cane seed	5	Pounds	3,000	600	.02	60	12.00
Corn, Indian	1,162	Bushels	18,915	16	.69	13,092	11.26
Corn, sorghum	482	...do	10,063	20	.70	7,062	14.65
Corn, fodder	1,870	Tons	1,438	0.8	4.74	6,819	3.64
Cotton lint	456	Pounds	152,044	333	.12	17,767	38.96
Cotton seed	456	...do	321,104	704	.014	4,578	10.03
Fruit, miscellaneous	5	...do	3,500	700	.05	175	35.00
Garden	42					2,080	49.52
Hay, miscellaneous	91	Tons	158	2	7.79	1,232	13.53
Oats	194	Bushels	10,853	55	.59	6,508	33.54
Pasture	486					4,568	9.39
Peaches	201	Pounds	841,000	4,184	.01	8,822	43.89
Wheat	11	Bushels	252	23	1.24	313	28.45
Less duplicated areas	4,170						
Total cropped acreage.	11,322	Total and average				245,684	21.70

		Areas.	Acres.	Farms.	Per cent of project.
Irrigated, no crop:		Total irrigable area farms reported	15,086	325	61
Fall planting of oats and		Total irrigated area farms reported	13,470	325	54
wheat	2,148	Under water-right application	13,470	325	54
		Total cropped area farms reported	11,322	325	46
Total irrigated acreage	13,470				

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, FEBRUARY 24, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, notice is hereby given that hereafter until further notice for all lands under the Carlsbad project, New Mexico, the operation and maintenance charge for any irrigation season shall be due and payable on March 1 of the following calendar year.

2. The operation and maintenance charges for the irrigation season of 1916, and for each irrigation season thereafter until further notice, shall be due on March 1 of the following year, and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of $1.25, which will permit delivery of not more than 1 acre-foot per acre: For the first acre-foot per acre additional the charge shall be 15 cents per acre-foot, 25 cents for the second, 40 cents for the third, 60 cents for the fourth,

and should further quantities be needed they will be furnished at the rate of 75 cents per acre-foot.

3. The provisions of this public notice cover all lands subject to public notice heretofore issued for the said project.

4. Except as hereinabove provided all the terms and provisions of existing public notices and orders, and in particular the public notice of March 2, 1915, for the Carlsbad project, shall remain unchanged.

Andrieus A. Jones,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 722.]

Feature costs of Carlsbad project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys		$41,081.56
Storage system:		
Third reservoir	$3,146.33	
McMillan Reservoir	112,894.64	
Avalon Reservoir	315,989.46	
General expense	632.01	
		432,662.44
Canal system:		
Main Canal	187,830.29	
East Canal	9,436.95	
Black River Cut-Off Canal	17,229.17	
Black River Canal	23,609.63	
Flumes	20,856.00	
Dark Canyon siphon	30,862.33	
Wasteways	29,621.29	
General expense	856.97	
		320,302.63
Lateral system:		
Preliminary work	5.40	
Laterals and sublaterals	49,201.71	
Flume, Avalon	912.49	
Siphon, Avalon	5,373.37	
General expense	607.09	
		56,100.06
Drainage system:		
Preliminary and general work	2,494.09	
Open drains	20,265.26	
Closed drains	33,660.72	
General expense	1,450.99	
		57,871.06
Permanent improvements and land:		
Buildings	3,192.19	
Real estate and permanent improvements	152,057.31	
		155,249.50
Plant accounts		15,904.51
Operation-and-maintenance charges transferred to and compounded with construction charges		1,934.00
Gross cost of construction of project to June 30, 1916		1,081,106.36
Less revenues earned during construction period:		
Rental of buildings	578.00	
Rentals of irrigation water	8,163.35	
Other revenues, unclassified	2,357.88	
Profit on hospital operations	[1] 150.51	
		10,948.72
Net cost of construction of project to June 30, 1916		1,070,157.64

[1] Deduct.

Estimated cost of contemplated work, Carlsbad project, during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Storage works, McMillan Dam		$150,000
Lateral system, laterals and sublaterals		24,000
Drainage system:		
Open drains	$15,000	
Closed drains	5,000	
		20,000
Permanent improvements and land		50,000
Operation and maintenance under public notice		25,000
Messes		3,000
Mercantile stores		6,000
Hospitals		1,000
Total		279,000

NEW MEXICO, HONDO PROJECT.

L. E. FOSTER, project manager, Carlsbad, N. Mex.

LOCATION.

County: Chaves.
Townships: 11 and 12 S., Rs. 22, 23, and 24 E., New Mexico meridian.
Railroad: Atchison, Topeka & Santa Fe Ry.
Railroad station and estimated population, January 1, 1916, Roswell, N. Mex., 7,500.

WATER SUPPLY.

Source of water supply: Hondo River.
Area of drainage basin: 1,037 square miles.
Annual run-off in acre-feet of Hondo River at the diversion dam (1,037 square miles), 1903 to 1914: Maximum, 90,500; minimum, 2,100; mean, 29,000.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service was prepared to supply water season of 1916: 1,650 acres.
Area under rental contracts season of 1916: 1,650 acres.
Length of irrigating season: From March to November—245 days.
Average elevation of irrigable area: 3,750 feet above sea level.
Rainfall on irrigable area: 20 years, average, 15 inches; 1915, 17.12 inches.
Range of temperature on irrigable area: 0° to 100° F.
Character of soil of irrigable area: Rich alluvium.
Principal products: Alfalfa and fruits.
Principal markets: Roswell, N. Mex.; Kansas City, Mo.; Chicago, Ill.; and Texas cities.

LANDS OPENED FOR IRRIGATION.

No lands have been opened for irrigation by public notice; 1,224 acres were irrigated under rental contracts to December 31, 1914.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys begun in 1903.
Construction recommended by board of engineers June 6, 1904.
Construction authorized by Secretary September 6, 1904.
Hondo Reservoir site purchased December 3, 1904.
Hondo Reservoir and inlet canal completed August, 1906.
Distributing canals completed April, 1907.
Project completed May, 1907.

IRRIGATION PLAN.

The irrigation plan of the Hondo project provides for the diversion of water from the Hondo River about 12 miles southwest of Roswell, N. Mex., through a short inlet canal, into a natural storage reservoir, the capacity of which is increased by embankments; the return of stored water to the river, and the diversion of water from the river by three dams, 2, 4, and 6 miles, respectively, below the reservoir, into canal systems watering lands in the vicinity of Roswell,

N. Mex. The United States claims all waste, seepage, spring, and percolating water arising within the project and proposes to use such water in connection therewith.

All features of this project are completed.

SUMMARY OF GENERAL DATA FOR HONDO PROJECT TO JUNE 30, 1916.

Areas:			
Irrigable acreage when project is complete			10,000
Public land entered, June 30, 1916		240	
Private land, June 30, 1916		9,760	
Acreage service could have supplied season of 1915			3,330
Acreage actually irrigated, season of 1915			1,294
Acreage cropped under irrigation, season of 1915			1,287
Crops:			
Value of irrigated crops, season of 1915			$17,778.00
Value of irrigated crops, per acre cropped			$13.81
Finances:			
Estimated cost of completed project			$339,491.68
Total construction cost to June 30, 1916			$339,491.68
Per cent complete, June 30, 1916			100
Appropriation for fiscal year 1917, total			$4,000
Estimated per cent complete, June 30, 1917			100
Appropriation, fiscal year 1916			$6,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$3,198.39		
Transfers	477.55		
		$3,675.94	
Registered liabilities chargeable to 1916 appropriation		310.98	
			$3,986.92
Unencumbered balance, July 1, 1916			$2,013.08
Repayments:			
Water rental charges—			
Accrued to June 30, 1916			$8,229.40
Collected to June 30, 1916			8,225.70
Uncollected, June 30, 1916			3.70

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

STORAGE WORKS.

Proposals were opened on September 6, 1904, and contracts were entered into on December 5, 1904, for the construction of Hondo reservoir and its related structures and canals. The work included the construction of a diversion dam on Hondo River, an inlet canal about 2 miles in length from the diversion dam to the reservoir site, embankments to convert a natural depression into a satisfactory storage reservoir, an outlet canal from the reservoir to Hondo River below the diversion dam, and the necessary controlling works.

The contractor for rock work began operations in January, 1905, and continued the work to successful completion in July, 1905. The contractor for the remainder of the work began operations in January, 1905, but was unable to continue the work successfully. The contract was suspended on June 7, 1905, and the construction was then carried on by Government forces until other arrangements could be made.

In July, 1905, W. H. Sanders, consulting engineer, recommended the reletting of the contract for embankments 3 and 4 and the completion of the remainder of the work at the reservoir by Government forces. In compliance with this recommendation, proposals were requested for the construction of embankments 3 and 4, and a contract for this work was entered into on November 13, 1905. The contract was completed satisfactorily in June, 1906. The work on the reservoir by Government forces was completed in August, 1906. The contracts for the construction of the reservoir and accessory canals and structures were let on a basis of bids totaling about $123,000. Increases over the estimated quantities of earth and rock excavation, overhaul, riprap, concrete, and other items of work caused an increased cost of a little over 50 per cent on the basis of the bids. The accepted bids were, however, less than the character of the work justified. Poor management and inefficient equipment in the execution of the contract and increasing construction costs combined to make the actual cost much higher than the estimated contract price. The construction was therefore done at a loss to the contractors, and the cost to the United States was considerably more than was at first anticipated.

DISTRIBUTION SYSTEM.

The plan of the distribution system provides for the discharge of water from the outlet canal of the reservoir into Hondo River, which is used as the main canal for the distribution system. Two miles southeast of the reservoir a dam diverts water for division A of the distribution system; about 3½ miles south of the reservoir is the diversion dam of division B; about 6 miles east of the reservoir is the diversion dam of division C.

Proposals for the excavation of the canals and laterals in the distribution system were opened on February 1, 1906, and a contract for the execution of this work was entered into on March 2, 1906. The work under this contract was begun on March 5 and was finished in June, 1906.

All structures of the distribution system were erected by Government forces and were completed by April, 1907.

A preliminary investigation was commenced on February 21, 1913, to determine the cost of conducting water to be diverted from the Hondo River, at a point near the Diamond A ranch, into a proposed concrete-lined canal 12 miles in length and delivering it to the first diversion of the Hondo project. The work was under the immediate charge of Jay D. Stannard, engineer, and was completed April 23, 1913. The project was visited by Mr. F. W. Hanna, supervising engineer, on April 22, 1914, at which time consideration was given to the proposed concrete canal. A meeting was arranged at this time with representative water users and the proposition of building the canal was discussed.

CONSTRUCTION DURING FISCAL YEAR.

There was no construction during the fiscal year on the Hondo project.

OPERATION AND MAINTENANCE.

The entire distribution system was used during the year; the water from the river was diverted direct into the canal system, the condition of the reservoir and the water supply making it impossible to use the reservoir. The water available came in small floods of short duration, as usual. There are no weirs or masonry boxes on the project, and water measurements are made with a current meter at the reservoir and divided to the laterals without measurement. Maintenance has consisted of keeping the lateral system free of weeds and silt.

Historical review, Hondo project.

Item.	1910	1911	1912	1913	1914	1915
Acreage for which service was prepared to supply water	....	1,100	1,200	1,000	1,224	3,330
Acreage irrigated	....	1,136	1,261	932	1,224	1,294
Miles of canal operated	12½	12½	12½	12½	12½	12½
Water diverted (acre-feet)	4,225	21,020	13,062	3,868	22,783	38,135
Water delivered to land (acre-feet)	1,170	1,049	1,640	800	1,108	1,238
Per acre of land irrigated (acre-feet)	0.90	0.90	1.30	0.86	0.91	0.96

SETTLEMENT.

There has been no additional settlement on this project for a number of years, due to the uncertainty of the water supply.

Settlement data, Hondo project.

Item.	1912	1913	1914	1915
Total number of farms in project	26	22	25	29
Population	85	77	90	102
Number of irrigated farms	23	22	25	29
Operated by owners or managers	16	12	14	16
Operated by tenants	7	[1] 15	16	13
Population	70	77	90	102
Number of towns	1	1	1	1
Population	7,000	7.000	7,000	7,500
Total population in towns and on farms	7,085	7,077	7,090	7,602
Number of public schools	3	3	3	3
Number of churches	9	9	9	9
Number of banks	4	4	4	4
Total capital stock	....	....	$350,000.00	$350,000.00
Total amount of deposits	....	....	$2,553,425.16	[2] $2,500,000.00

[1] Five farms not occupied.

[2] Estimated.

PRINCIPAL CROPS.

The principal crops are alfalfa, sorghum head corns, apples, and peaches. The orchards are all in poor condition and are rapidly dying out. Fairly good results were obtained during the season of 1915 with alfalfa and the sorghum head corn, although the per acre value was smaller. Crops generally are fed to live stock. A first cutting of alfalfa hay was obtained during the early part of 1916, but the yield of hay and annual crops will be small on account of the water supply after May 15.

Crop report, Hondo project, New Mexico, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	716	Tons	1,465	2	$7.91	$11,590	$16.18
Apples	61	Pounds	28,300	468	.14	410	6.72
Cane	105	Tons	160	1.5	7.34	1,175	11.19
Corn fodder	253	...do	426	1.8	6.93	2,953	11.67
Corn, Indian	60	Bushels	840	14	.75	630	10.50
Corn, sorghum	9	...do	100	11	.45	45	5.00
Fruit, miscellaneous	23	Pounds	18,000	800	.12	220	9.56
Hay, miscellaneous	50	Tons	66	1.3	6.06	400	8.00
Oats	10	Bushels	710	71	.50	355	35.50
Total cropped acreage	1,287	Total and average				17,778	13.81
		Areas.			Acres.	Farms.	Per cent of project.
Irrigated, no crop	7	Total irrigable area farms reported			3,330	29	33
		Total irrigated area farms reported			1,294	29	13
Total irrigated acreage	1,294	Under rental contracts			1,294	29	13

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 728.]

Feature costs of Hondo project to June 30, 1916.

Features.	Sub-feature.	Principal feature.
Storage works:		
Preliminary and general work	$4,422.70	
Dam and spillway (outlet excavation and embankment No. 5, schedule 3)	57,772.59	
Dam and spillway (storage reservoir embankments 1, 2, 3, 4, schedules 4 and 5)	96,246.60	
Dam and spillway (protection embankment and outlet canal ditch)	825.48	$159,267.37
Canal system:		
Diversion dam and headworks (rock excavation, etc., schedule 2)	35,536.31	
Diversion dam and headworks (headworks and earthwork, inlet canal, schedules 1 and 6)	58,362.38	93,898.69
Lateral system, laterals and sublaterals		38,979.34
Farm units		19,837.41
Permanent improvements and lands		23,338.45
Telephone system, telephone lines		4,170.42
Operation and maintenance during construction (water rental basis)		38,914.59
Plant accounts		270.00
Gross cost of construction of project to June 30, 1916		378,676.27
Less revenues earned during construction period:		
Rental of buildings	220.00	
Rentals of irrigation water	8,229.40	
Contractors' freight refunds	159.63	
Other revenues, unclassified	55.36	
Profit on hospital operations	[1] 78.00	8,586.39
Net cost of construction of project to June 30, 1916		370,089.88

[1] Deduct.

Estimated cost of contemplated work, Hondo project, during fiscal year 1917.

Operation and maintenance during construction (water rental basis)	$4,000

NEW MEXICO-TEXAS, RIO GRANDE PROJECT.

E. H. BALDWIN, senior engineer, El Paso, Tex.

L. J. CHARLES, construction engineer, Elephant Butte storage.

LOCATION.

Counties: Socorro, Sierra, Dona Ana, N. Mex.; El Paso, Tex.

Townships: 8 to 29 S., Rs. 3 E. to 5 W., New Mexico meridian.

Railroads: Atchison, Topeka & Santa Fe, El Paso & Southwestern, Southern Pacific, and Texas & Pacific.

Railroad stations and estimated population, January 1, 1916: Texas—El Paso, 70,000; Ysleta, 1,450; La Tuna, 500; Fabens, 450; San Jose, 350; Canutillo, 250; Clint, 250; and Vinton, 250. New Mexico—Las Cruces, 4,000; Mesilla Park, 1,850; Rincon, 400; Dona Ana, 250; Engle, 150; Berino, 50; Fort Selden, 50; Hatch, 50; Hill, 50; Leasburg, 50; Mesquito, 50; and Vado, 50.

WATER SUPPLY.

Source of water supply: Rio Grande.

Area of drainage basin: 37,000 square miles.

Annual run-off in acre-feet of Rio Grande: At San Marcial (30,000 square miles), 1895 to 1915, inclusive, maximum, 2,422,000; minimum, 200,700; mean, 1,140,110. At El Paso, Tex. (38,600 square miles), 1889 to 1914, inclusive, maximum, 2,010,000; minimum, 50,700; mean, 925,400.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916: 85,000 acres.

Area under rental contracts, season of 1916: 62,000 acres.

Length of irrigating season: From February 15 to November 15—274 days.

Average elevation of irrigable area: 3,700 feet above sea level.

Rainfall on irrigable area: 31-year average, 10.7 inches; 1915, 10.26 inches.

Range of temperature on irrigable area: —5° to 105° F.

Character of soil of irrigable area: Fertile alluvium and sandy loam.

Principal products: Alfalfa, corn, wheat, melons, fruit, and vegetables.

Principal markets: Towns in Texas, New Mexico, Louisiana, and eastern cities.

LANDS OPENED FOR IRRIGATION.

No lands have been opened for irrigation by public notice.

All lands in the Mesilla and El Paso Valleys are being irrigated under rental contracts.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys begun in March, 1903.

Construction of Leasburg unit recommended November 29, 1905.

Construction of Leasburg unit authorized December 2, 1905.

Reclamation act extended to Texas June 12, 1906 (34 Stat., 259).

Treaty with Mexico providing for distribution of waters of the Rio Grande proclaimed January 16, 1907.

Construction of Elephant Butte Dam authorized by Congress and $1,000,000 appropriated March 4, 1907 (34 Stat., 1357).

Leasburg unit completed July, 1908.

First irrigation by Reclamation Service (Leasburg unit), season of 1908.

Construction of Elephant Butte Dam authorized by Secretary May 23, 1910.

Construction plans of Elephant Butte Dam approved by board of engineers June 6, 1910, January 22, 1911, August 12, 1912, January 30, 1913.

Construction plans approved by Secretary October 26, 1910.

Franklin Canal purchased October, 1912.

First 11 miles of Franklin Canal reconstructed March, 1914.

Second section (8 miles) reconstructed 1915.

East Side Canal completed September, 1915.

West Side Canal completed November, 1915.

San Elizario Feed Canal completed April, 1916.

Elephant Butte Dam completed May 13, 1916.

Mesilla Diversion Dam completed May 31, 1916.

Leasburg Extension Canal and Picacho Branch Canal to station 121 completed May 31, 1916.

Project, exclusive of Elephant Butte storage, 24.4 per cent completed June 30, 1916.

Project, including Elephant Butte storage, 56.2 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Rio Grande project provides for the storage of flood waters of the Rio Grande in a reservoir controlled by Elephant Butte Dam, about 12 miles west of Engle, N. Mex., and the diversion of water from the Rio Grande, about 6 miles below the storage dam, for the irrigation of lands in Las Palomas Valley; about 24 miles below for watering lands in Rincon Valley; about 60 miles below for the irrigation of 28,000 acres in the upper Mesilla Valley under the Leasburg Diversion Dam; about 80 miles below for the irrigation of 57,000 acres in the lower Mesilla Valley under the Mesilla Dam; and about 120 miles below for supplying water to lands in El Paso Valley and furnishing 60,000 acre-feet per annum for use on land in El Paso Valley on the Mexican side of the Rio Grande. The United States claims all waste, seepage, spring, and percolating water arising within the project and proposes to use such water in connection therewith. All irrigation works required for Las Palomas and Rincon Valleys will be new; those for the Mesilla Valley include a diversion dam and 10.8 miles of canal now constructed, as well as a diversion dam 5½ miles southwest of Las Cruces and 27 miles of canal leading therefrom, which have also been constructed; and those required for El Paso Valley will supplement and improve present canal systems.

The features of the above irrigation plan that have been completed are the diversion dam, headworks, and main canal for the 28,000 acres in the upper Mesilla Valley unit; the construction of the Mesilla Diversion Dam and East Side and West Side Canals in the lower Mesilla Valley; the reconstruction of a portion of the Franklin Canal; and the construction of the San Elizario Feed Canal in the El Paso Valley.

SUMMARY OF GENERAL DATA FOR RIO GRANDE PROJECT TO JUNE 30, 1916.

Areas:		
Irrigable acreage when project is complete		155,000
Public land entered, June 30, 1916	300	
Public land withdrawn, June 30, 1916	5,143	
State land, June 30, 1916	2,602	
Private land, June 30, 1916	146,955	
Acreage service could have supplied season of 1915		45,000
Addition in fiscal year, 1916		40,000
Estimated addition in fiscal year 1917		3,000
Estimated acreage service can supply July 1, 1917		88,000
Acreage actually irrigated, season of 1915		33,876
Acreage cropped under irrigation, season of 1915		32,246
Crops:		
Value of irrigated crops, season of 1915		$1,103,388.00
Value of irrigated crops, per acre cropped		$34.22

Finances:			
Estimated cost of completed project			$6,706,700.00
Total construction cost to June 30, 1916			$1,626,089.44
Per cent complete, June 30, 1916			24.4
Appropriation for fiscal year 1917, total			$637,000.00
Allotment for construction, fiscal year, 1917			$637,000.00
Estimated per cent complete, June 30, 1917			33.80
Appropriation, fiscal year 1916			$657,612.16
Expenditures during fiscal year chargeable to 1916 appropriation:			
Disbursements	$278,844.36		
Transfers	18,933.15		
		$297,777.51	
Registered liabilities chargeable to 1916 appropriation		33,665.76	
			$331,443.27
Unencumbered balance, July 1, 1916			326,168.89
Repayments:			
Water-rental charges—			
Accrued to June 30, 1916			212,453.25
Collected to June 30, 1916			164,903.53
Uncollected, June 30, 1916			47,549.72
Drainage:			
Estimated acreage damaged by seepage to June 30, 1916			40,000
Miles of drains built to June 30, 1916, open			1.8
Estimated acreage to be protected			155,000

ELEPHANT BUTTE STORAGE UNIT.

Finances:			
Estimated cost of completed project (previous estimate)			$5,062,000.00
Total construction cost to June 30, 1916			$4,931,864.46
Per cent complete, June 30, 1916			99.50
Appropriation for fiscal year 1917, total			$23,550.00
Allotment for construction, fiscal year 1917			$23,550.00
Estimated per cent complete, June 30, 1917			100.00
Appropriation fiscal year 1916			$607,387.84
Expenditures during year, chargeable to 1916 appropriation:			
Disbursements	$390,377.15		
Transfers	25,212.05		
		$415,589.20	
Registered liabilities chargeable to 1916 appropriation		31,190.67	
			446,779.87
Unencumbered balance, July 1, 1916			160,607.97

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

LEASBURG DAM AND APPURTENANT STRUCTURES.

The construction features of the Leasburg unit consist of a reenforced rubble concrete weir resting on piles and on two cut-off walls of sheet piling; a rubble concrete abutment at the west end of the weir resting on round piles and sheet piling; an earth embankment about 1,500 feet long extending from the west abutment of the dam to high ground; a sluice way with three openings cut through Penasco Rock, which forms the east abutment of the dam; a canal intake with five openings just east of the sluiceway; a concrete wall connecting the sluiceway and canal intake; a 520-second-foot canal about 6 miles in length extending from the intake to an old river channel leading to existing irrigation ditches, and structures on the canal, including a sand sluiceway, two cross drainage structures and two drops; and a change of river channel about 1 mile long. The diversion weir is about 600 feet long and 9 feet in maximum height.

The original plans provided for timber drops and cross-drainage structures, but the drops were constructed of concrete. The change of river channel included the excavation of an open cut about 1 mile long and the construction of a spur dike, built of piles, wire, and brush weighted with bowlders, for deflecting the river into the cut.

The above-described features were advertised for construction under specifications No. 110. Proposals were opened on October 16, 1906, and a contract for the work was executed soon after that date. Earth excavation on the canal progressed satisfactorily between November 29, 1906, and May 1, 1907, when the excavation was 88 per cent completed. The earth embankment at the west end of the diversion dam was practically completed by March 19, 1907. Excavation and pile driving for the change of river channel were completed by April 16, 1907. Work on the concrete weir, the abutments, the sluiceway, canal headworks, and other structures on the canal was delayed by slow delivery of materials, and floods of the river caused extensive delays in the completion of the contract. Gravel and bowlder deposits about 10 feet below the foundation of the weir made the driving of timber and sheet piling very difficult. The work on the contract was finally completed on February 14, 1908.

MESILLA DIVERSION DAM AND EAST AND WEST SIDE CANALS.

In accordance with the recommendation of boards of consulting engineers in reports dated December 4, 1913, and October 19, 1914, and after 80 per cent of the landowners had signed contracts agreeing to take water from, and pay for the operation of, the works to be built, construction was started on the Mesilla Diversion Dam, and the East and West Side Canals leading therefrom, for the irrigation of the lower part of the Mesilla Valley on each side of the river. The East Side Canal, with a capacity at the head of 240 second-feet, and a length of 10.5 miles, was completed in September, 1915; the West Side Canal, with a capacity at the head of 500 second-feet and a length of 14.4 miles, was completed in November, 1915. Water was diverted through the heading at Mesilla Dam November 5, 1915, but the regular heading for the West Side Canal was not placed in operation until April 21, 1916, water for this canal being supplied through a temporary diversion previous to that time.

The Mesilla Dam consists of a low concrete weir 303 feet long, surmounted by 13 tainter gates, each 21 feet 7 inches long, and 9 of them 4 feet 6 inches high, while 2 at each end of the dam, to be used as sluice gates, are 6 feet 3 inches high. Water is admitted to the canals through regulating works placed at right angles to the axis of the dam and controlled by sliding gates 4 feet 4 inches wide by 3 feet 9 inches high, with their sills 2 feet 10 inches above the sill of the sluice gates. There are 8 of these gates in the west heading, and 6 in the east heading. The dam was completed and turned over to the operation and maintenance department June 1, 1916.

FRANKLIN CANAL.

Negotiations for the purchase of the Franklin Canal in the El Paso Valley were begun in October, 1911, and formal transfer of the property made October 14, 1912. Reconstruction and enlargement of the first 15 miles of this canal, for a capacity of 450 second-feet, were begun in December, 1913, and completed in March, 1914. Reconstruction of the second division of 7 miles for a capacity varying from 450 to 193 second-feet, was begun in December, 1914, and completed in March, 1915. The reconstruction of the third division of 10 miles remains to be done. The main consideration in the purchase of this canal was to secure its valuable right of way, over 5 miles of which run through the city of El Paso.

SURVEYS.

As the land holdings on the project do not conform to land-office subdivisions, but are very irregular owing to a larger part of them coming down through the old Spanish grants, and as no reliable maps of the holdings were in existence, surveys for the purpose of preparing suitable maps showing also detailed topography were made of the Leasburg unit in 1909. Detail topographic surveys of the El Paso Valley were also made in 1909. In June, 1912, the work of mapping the remainder of the Mesilla Valley was started, and completed about December, 1913. January 1, 1912, similar surveys were begun in the Rincon Valley and completed July, 1913. Farm unit surveys were made in the Palomas Valley during March and April, 1915. Surveys to determine property holding in the El Paso Valley were begun in December, 1914, and completed in May, 1915.

In response to requests from the water users' associations surveys for a high-line canal in the Mesilla Valley were begun in February, 1910, and continued intermittently until November, 1913. A high-canal survey was also made in the Palomas Valley in the fall of 1912. The object of these high-line canals, if found feasible, was to not only cover some of the bench lands by irrigation, but also to develop power in connection with their operation. This high-line canal system was unfavorably reported upon by a board of consulting engineers in a report dated December 4, 1913, and the present system of canals recommended.

In case it should be decided to incorporate the existing community ditches in a lateral system for the project, it was deemed necessary to make surveys to determine their size, capacity, grade, and alignment. These surveys were made in the Rincon and Mesilla Valleys during the summer and fall of 1914, and in the El Paso Valley in the spring of 1915.

ELEPHANT BUTTE DAM AND APPURTENANT STRUCTURES.

The Elephant Butte Dam is a rubble concrete gravity, straight structure, 318 feet in height, and with a length on top, including the spillway, of 1,674 feet.

Preliminary work.—Preliminary surveys had been made and some preparatory work done toward the building of a construction camp at the dam site prior to May, 1909. Between May, 1909, and July, 1910, all work on the storage unit was suspended on account of the failure of negotiations for the purchase of the necessary lands for reservoir purposes and railroad right of way. Condemnation proceedings were consummated and the camp reopened in July, 1910.

Elephant Butte Railroad.—Government forces started work immediately on the construction of the branch railroad connecting with the Atchison, Topeka & Santa Fe Railroad, and continued to completion that portion of the roadbed from the dam to station 62+50. In the meantime advertisements for bids for the construction of the remainder of the railroad grading and two trestles were prepared and issued, with the result that the railroad and trestle contracts were awarded and work started in August, 1910. The railroad was completed and train service inaugurated March 2, 1911. Prior to this time all machinery, materials, and supplies were hauled by wagon from Engle, a distance of 12 miles.

Drilling.—In October, 1910, a diamond-drill outfit was started at the proposed dam site to make further explorations of the rock foundations. A second drill was put in operation January, 1911. The information resulting from this work fixed the location of the dam and showed that the sand and gravel in the bed of the river were suitable for concreting purposes.

Practically all roads were built in 1910 and 1911; the wagon bridge was completed and put in service June 26, 1911.

Other preliminary construction.—As part of the preliminary work there were also constructed in 1910 and 1911 a permanent water supply system for both construction and domestic purposes, bathhouses, sewers, septic tanks, sanitary conveniences, and the following camp buildings: 3 quarter houses, 2 mess houses, 28 cottages, 51 tent houses, 1 jail, 1 hospital, and 1 mercantile store.

Following is a list of construction plant buildings erected at the end of 1911: Steam power plant (nearly completed), 4 storehouses, oil house, powder house, machine shop, 3 blacksmith shops, tool house, coal chutes, lumber shed, hay shed, barns at main corral, barn at corral No. 2, main office building, laboratory building, and a number of small miscellaneous buildings.

The local telephone system consists of a 25-drop switchboard in the office building, with about 40 telephones located at convenient points on the work. This was completed in 1911.

At the end of 1911 quarry No. 1 was opened up for the delivery of rock, excavation for the spillway was well under way, flume excavation was completed, flume concrete about half completed, and work on the cofferdams progressing satisfactorily.

Plans for the mixing plant were prepared in 1911; excavation for foundation piers was started in January, 1912; and the concrete piers completed in February, 1912. The plant, except for the hydraulic gate operating mechanism was ready for the delivery of concrete in

September, 1912. At the end of 1912 the concrete haulage engine was in place and the mixing-plant building entirely completed except for the hydraulic operating mechanism. The cableways were completed and put in service first for handling concrete and supplies for the flume and later for excavating purposes. The flume was completed and the river diverted to its new channel November 6, 1912. Cableway excavation by grab buckets was started at once. Some work was done at quarry No. 1 in 1912, but the bulk of rock quarried was obtained from quarry No. 2.

A dike was built in 1912 along the river bank at the lower town for protection against possible flooding during the spring floods.

Work on the sand-cement plant was started in October, 1912; the plant was completed and put in operation early in March, 1913. Other units completed and put in operation in 1912 were main rock-crushing plant, compressors, track scales, and a semipermanent pumping plant at the town site.

Actual construction begun.—With the camp buildings completed, the plants rapidly rounding into shape for operation, and the work of excavating for the dam foundation well under way, attention was diverted from the preliminary operations to that of actual construction. The sand-cement, mixing, and crushing plants were rushed to completion, and everything put in readiness for concrete work on the dam. A section of bed rock east of the flume to station 6+44 was completed and the first concrete poured June 3, 1913. From this time until the completion of the dam all operations were directed and timed to produce the greatest possible output of concrete in the shortest time. Bedrock was exposed and prepared for concreting only when more space was required to advance work on the dam.

A concreting program was prepared in advance of the work to properly time concrete placing in the winter and summer blocks. This was necessary also in following out the contraction joint scheme.

Two shifts only were devoted to the placing of concrete; the third, or "graveyard," shift was used in delivering plum rock, cleaning concrete and rock surfaces, and in general preparations for the next day's run.

Concreting records.—The output for the month of January, 1915, stands as the record for concrete placed in any one month, and the output on the 25th of the same month as the highest daily record. The January output of 38,400 cubic yards was not the result of continuous work, for during the latter part of the month parts of two shifts were lost by bad weather, and work on the 6th, the date of flume closure, was reduced by one shift entirely and a decreased output on the other. The losses at this time were partially offset by the introduction of a third shift on the 7th and 8th.

The daily record of 2,651 cubic yards on the 25th of the same month was made in two shifts of 16 working hours. Concrete was delivered from the three mixers on the day shift at the rate of 2.7 cubic yards per minute; this was handled on the dam from the three cables besides setting 376 cubic yards of plums and spalls.

The height of construction operations was reached in the latter part of 1914, when concrete work on the dam had reached the point where installation of gates was necessary and the construction of the earthen embankment was undertaken. Some gate material arrived in January, 1914, but installation was not undertaken until September. This work was carried on as rapidly as pouring conditions would permit. Work on the embankment or earthen dike located about a mile west of the dam was started in October, 1914, and completed June 30, 1915.

The permanent Engle Road was started in 1912, but was not finished. Work on this feature was resumed in October, 1914, and finished early in 1915. There were two other permanent roads built to connect the east end of the dam with the permanent road system in the early part of 1916, and a short section of road at the west end of the spillway to connect the roadway across the dam with the embankment road.

Closure of the flume was successfully accomplished January 6, 1915. This act inaugurated the beginning of the Elephant Butte Reservoir and made possible the use of the gate installation for the first time.

Construction of the 150 kilowatt hydroelectric plant was started July 16, but was not completed and put in operation until November 12, 1915.

Spillway excavation.—Excavation for the spillway was begun March 5, 1915, and the first concrete poured June 26, 1915. At the end of 1915 arches were in place, cylinder gate towers were completed to roadway level, and about half of the sand cement backfill between the roadway crown and arches poured. Except for the cylinder gate installation and grouting of foundation the spillway was completed in February, 1916.

Completion of the dam.—Dam concreting was completed May 13, 1916, except for a small amount of concrete in the form of covers for drainage wells, which can not be poured until after the wells are drilled. At the end of the fiscal year 1916 all work on the dam was completed, except for drilling of drainage wells and the grouting of five holes at the western end of the dam.

Demolition of plants and buildings and the storage of equipment at Engle are practically completed.

Drainage wells.—Drilling of drainage wells for the purpose of intercepting seepage water in the bedrock to a depth of 45 feet below the concrete and conveying the water to the drainage gallery for safe passage through the dam has been one of the most important features of the construction of the Elephant Butte Dam. The direct result of this work is to be found in the fact that measurement of the seepage is possible at any time. When measurements show a large increase in the flow from a well, especially if the water should be turbid or slightly muddy, steps are taken to grout the hole and thus stop the scour. This has been done successfully in two instances. At the end of the fiscal year 1916 the total seepage through drainage wells and around the east abutment amounted to only 110 gallons per minute, about 0.25 of a cubic foot per second.

Grouting.—Grouting of the bed rock is no less interesting, because tightness of the foundation depends largely on the success of this operation. Grouting holes were drilled at 10-foot intervals from the east to the west end of the dam to a depth of 45 feet in the bedrock and grouted with a Canniff self-stirring grouting machine. That there was need for such work is evidenced by the fact that about 2,370 barrels of cement were forced through these holes into the bedrock under air pressure varying from 10 to 100 pounds.

Plastering of the upstream face of the dam with grout by the cement gun was started at the lowest exposed area of the face, and continued first from the ground and scaffolding, and later, after the sump filled and the storage of water began, by rafts. The work was completed from scaffolding hung from the top of the dam.

The purpose of the grouting was to make the upstream face impervious. This precaution was taken in addition to that of using a richer mix of concrete at the face.

CONSTRUCTION DURING FISCAL YEAR.

Elephant Butte Dam.—Concrete work was carried on with one cable working one shift from July 1 to November 1, 1915, two shifts and one cable from November 1, 1915, to January 20, 1916, and one shift from January 20 to completion of concreting May 13, 1916.

The total volume of masonry in the dam, exclusive of the spillway, is 605,200 cubic yards; of this amount 63,870 cubic yards were placed in the fiscal year just ended.

As the dam neared completion, there was an increasingly large reduction in the amount of concrete placed daily, caused chiefly by cramped working conditions and delays incidental to setting forms for parapet walls, roadway details, and architectural detail forms on both faces.

Bottom dump buckets were substituted for skips August 30, the straining tower was completed in January, and operation of the concrete-haulage system was discontinued March 21.

Installation and wiring of lamp posts followed completion of concreting very closely. The dam was lighted for the first time on May 26, 1916.

Excavation for dam foundation was carried on throughout the year. New work, however, was not undertaken unless there was need for more concreting space, thus obviating the necessity for unduly exposing bedrock to the action of the weather. The total quantity of material excavated for the dam was 407,230 cubic yards; of this amount 8,330 cubic yards were removed in the fiscal year.

Except for a delay of about three weeks drilling of grouting holes and drainage wells was continuous. Operation from July 1 to February 9 was on a one-shift basis, February 9 to April 1 two shifts, April 1 to June 30 three shifts, resulting in a total depth drilled of 12,150 feet.

Cement gun work was completed in May. The total space covered with Gunnite is 180,420 square feet.

Foundation grouting was carried on intermittently. At the end of the year this work was completed except for five holes under "A" tail tower, which can not be drilled until the tower is taken down.

Construction of the hydroelectric plant was started July 16, but owing to the pressure of other work was not completed until November 12. The turbine was put in operation on that day and worked one shift daily from 12 midnight to 8 a. m. until November 21, when the flywheel cracked; this accident caused suspension of operation until January 18, 1916. Since that time operation has varied with the demand for power. The total output to June 30 was 145,050 kilowatt-hours.

Operation of the steam-power plant was discontinued June 3, after having been in almost continuous operation since February, 1912. Dismantling of turbine unit No. 1 was started February 18; at the end of the year the plant was 80 per cent dismantled. The total output of the plant was 10,509,770 kilowatt-hours, of which amount 1,069,400 kilowatt-hours were generated in the fiscal year 1916.

Operation of the sand-cement plant was discontinued on January 24. Dismantling of machinery was started on the 25th. The total output was 621,550 barrels.

Employees in July averaged 367 men, in January 356, and in June 172. There were 29 head of stock on the job during the first 10 months of the year and 9 at the end, 20 having been transferred to another project.

There were a few heavy rains which delayed work somewhat, but taken as a whole the weather was favorable for field work.

There was a net gain in the reservoir of 385,000 acre-feet of water and 25.82 feet in depth. The elevation of reservoir was 4,346.02 feet, and the water in storage 882,900 acre-feet on June 30.

Spillway.—At the beginning of the fiscal year excavation was well under way, and a small amount of concrete had been placed in the four tunnel outlets. Concreting of paving, bridge piers, abutments, arches, gate towers, parapet walls, and roadway details followed in the order named. Concrete work was completed on February 16, and the structure was ready for service in May.

As an additional protection against faulty and seamy bedrock 21 holes were drilled upstream from the axis and grouted.

The total excavation made for the spillway was 47,120 cubic yards, concrete in structure 5,800 cubic yards, feet of hole drilled for grouting 1,596.

Miscellaneous work.—During the year a permanent gaging station was built at the lower town site, a silt survey of the reservoir was started, the Atchison, Topeka & Santa Fe Railroad pipe line between Engle and the pumping station in the Arroyo del Muerto was surveyed, a permanent walkway was built on the downstream face of the dam, the roadway on the dam was connected to the permanent road system by the construction of two short roads, and the balanced valves were dismantled, cleaned, oiled, and reassembled.

Dismantling of plant.—The work of demolition has been under way since January. At the end of the year it was about 80 per cent completed. Dismantled machinery, lumber, etc., not held for transfer was shipped to Engle, N. Mex., for storage in the storage yard there.

Leasburg Extension Canal.—Construction of the extension of the Leasburg Canal from station 310 to 570, to give a better water supply to the Las Cruces and Mesilla community ditches in the upper Mesilla Valley, was started in December, 1915, and completed May 31, 1916. At the same time the Picacho Branch Canal leading from the Leasburg extension, for the irrigation of approximately 5,000 acres in the Picacho district on the west side of the river, was constructed to station 121 on the east bank of the river, at which point a flume is to be constructed across the river. One hundred and nine thousand five hundred cubic yards of class 1 material were excavated on the Leasburg extension, and 28,300 cubic yards on the

Picacho Branch canals, nearly all by contract. In addition to this, four bridges, three concrete drops, one wasteway, one large combination structure, and several minor structures on the Leasburg extension, and several minor structures on the Picacho Branch Canal were constructed by Government forces.

Mesilla Diversion Dam and Canals.—In the lower Mesilla Valley the Mesilla Diversion Dam, embracing the excavation of 47,275 cubic yards of earth and the placing of 2,876 cubic yards of concrete, 1,070 cubic yards of riprap and paving, and 137,443 pounds of gates and machinery, was completed May 31, 1916, by Government forces. The East Side Canal heading at the Mesilla Dam was completed in September, 1915; 267,600 cubic yards of earth were excavated, and 977 cubic yards of concrete and 476 cubic yards of paving were placed, all by Government forces. The West Side Canal, also heading at Mesilla Dam, and the Chamberino Feed Canal, leading from the West Side Canal to the Chamberino community ditch, were completed in November, 1915. The total material in the two canals was 563,870 cubic yards of class 1 earth, 1,924 cubic yards of concrete, and 2,442 cubic yards of paving; all work was done by Government forces. The work on the Mesilla Dam and the East and West Side Canals was begun in December, 1914.

Franklin Canal and San Elizario Feed Canal.—In the El Paso Valley a large wasteway was built at station 78 of the Franklin Canal. In December, 1915, work was started on the San Elizario Feed Canal, heading at station 780 Franklin Canal, and extending 3.2 miles to the San Elizario community ditch, also supplying water to the Socorro community ditch. The canal was completed in April, 1916; 43,756 cubic yards of class 1 material were moved by contract; 975 cubic yards of concrete were placed in 0.46 mile of canal lining; and 218 cubic yards of concrete and 110 cubic yards of paving were placed in structures by Government forces.

Surveys.—Farm-property surveys were completed early in the fiscal year, as well as the surveys of the community ditches under the project. Several preliminary drainage lines have been run, and final location has been made on the lower ends of the Mesa drain in the El Paso Valley and the East River drain in the Mesilla Valley. A preliminary survey was made of Tornilla Valley, a tract of about 10,000 acres, lying below Fabens, Tex. This district has never been included in the project, but the survey was made with the idea that it might ultimately be included. Surveys for the final location of Percha Dam and the Arrey Canal were begun in May, 1916, preparatory to beginning construction. This work is located at the head of the Rincon Valley for the irrigation of that valley.

Drainage construction.—After the requirements of the commission with reference to the agreement to pay for the cost of a drainage system had been complied with by the two water users' associations, work of securing right of way on the first division of the Mesa drain in the El Paso Valley and the East River drain in the Mesilla Valley was begun, and finally sufficient right of way had been secured to warrant starting a drag-line machine at work on the East River drain the last of April and another machine on the Mesa drain the last part of May. By the end of the fiscal year a total of 2 miles had been excavated on the two drains; the total amount of class 1 material moved was 54,124 cubic yards.

SEEPAGE AND DRAINAGE.

While irrigation has been practiced for a great many years in the Rio Grande Valley, the necessity for drainage has not been apparent to the settlers until the past year, although it has been recognized and considered by the reclamation officials in all their plans and estimates except those first made. There are several contributing causes to the sudden change in ground-water conditions. Previous to the storage of water at Elephant Butte Dam, the Rio Grande carried a great deal of silt which was carried out upon the land during irrigation and formed a semi-impervious coating, allowing the water to penetrate very slowly into the soil. Usually there was a period of from one to three months when the river was practically or entirely dry, allowing no water to enter the soil. Since water has been stored, all silt has been dropped at the reservoir and the water now goes upon the land clear, or nearly so, allowing it to penetrate much more readily into the ground; and as the water users have not yet learned to cut down the amount of water applied, the result is a rapid rising of the ground-water level. This rise is also affected by the construction of additional canals in the past two years, and the fact that water is flowing constantly in all the canals and in the river. As the valleys are very flat and as they are in most cases confined by mountain ranges approaching to the river bank at their lower ends, with the probability of rock barriers cutting across, the rate of underflow and escape of the ground water is very slow. At the present time the ground water is very close to the surface on some portions of the project.

The matter has been submitted to the two water users' associations, which have voted that the Government shall expend not to exceed $10 per acre in the construction of a drainage system. Wells have been put down at intervals of about one-half mile, both in the Mesilla and El Paso Valleys, and monthly readings are taken to observe the elevation of the ground water. A tentative plan for main drains has been prepared for these two valleys, a portion of the ditches located, and one drag-line machine is at work in the El Paso Valley and another in the Mesilla Valley on the construction of a main drain. To date 2 miles of drain have been excavated. The placing of additional machines on this work to increase the rate of progress is being withheld pending the formation of drainage districts in accordance with a ruling of the Reclamation Commission.

ECONOMIES OF GOVERNMENT WORK.

On the Rio Grande project, exclusive of Elephant Butte, the only work performed has been the construction of a part of the canal system and two diversion dams. Part of this work has been done by contract and part by Government forces. The earthwork on two of the large canals and on a part of the reconstruction of the Franklin Canal was done by Government forces at the request of the water users in order to give employment to the farmers of the valley. The greater part of the remainder of the canal work and the construction of the Leasburg Dam was done by contract. On the work done by Government forces bids were not asked, and on the work done by contract the conditions were not comparable with those on the work done by Government forces, so that an intelligent comparison between contract work and work done by Government forces is not possible on this project.

Elephant Butte Railroad.—Assuming continuance of teaming contract for hauling supplies from Eagle, N. Mex., to the dam (unlikely at rate of 13 and 13.5 cents per 100 pounds, because of heavy valve pieces, etc.), hauling of 138,500 tons by railroad to May 31, 1916, saved approximately $150,000, allowing for the cost of the branch railroad.

Sand cement plant.—Operation of this plant resulted in a total output of 621,550 barrels of sand cement at a unit cost of $1.578 per barrel, or a total cost of $981,051.92, including cost of plant. Since one barrel of sand cement is equivalent to 0.926 barrel of Portland there would have been required in the construction of the Elephant Butte Dam about 575,000 barrels of straight Portland cement, which, at $2.13 per barrel, would have cost $1,224,750. The net saving to the Government through the use of sand cement, therefore, is the difference between the actual cost of sand cement and the estimated cost of Portland, or $243,699.

BOARD MEETINGS.

RIO GRANDE PROJECT, EXCLUSIVE OF ELEPHANT BUTTE DAM.

Date.	Purpose.	Personnel of board.
Oct. 22, 1904	Choice between Elephant Butte and International Dams, and general status of project.	A. P. Davis, W. H. Sanders, B. M. Hall.
June 15, 1906	Leasburg Dam and Canal	C. E. Grunsky, W. H. Sanders, B. M. Hall, W. W. Follett.
Mar. 27, 1913	High-line canal system in Mesilla Valley	A. P. Davis, L. C. Hill, D. C. Henny, L. M. Lawson, Homer J. Gault.
Nov. 25, 1913	Reconstruction of Franklin Canal	D. C. Henny, W. W. Follett, L. C. Hill, L. M. Lawson.
Dec. 4, 1913	Construction of Mesilla Valley West Side Canal.	W. L. Marshall, D. C. Henny, W. W. Follett, L. C. Hill, L. M. Lawson.
Do	Adverse report on construction of high-line canal system in Mesilla Valley, and recommending present system of canals.	W. L. Marshall, D. C. Henny, W. W. Follett, L. C. Hill, L. M. Lawson.
Oct. 19, 1914	Plans for Mesilla Dam, East Side and West Side Canals in Mesilla Valley, and extension of Franklin Canal in El Paso Valley.	W. L. Marshall, D. C. Henny, L. C. Hill, F. W. Hanna, L. M. Lawson.
Do	Flood and river control for Rio Grande project.	W. L. Marshall, D. C. Henny, L. C. Hill, F. W. Hanna, L. M. Lawson.
Apr. 7, 1915	Drainage	E. H. Baldwin, L. C. Hill, D. W. Murphy, L. M. Lawson.

ELEPHANT BUTTE STORAGE.

Jan. 24, 1911	Location of dam and methods to be used in construction.	A. P. Davis, L. C. Hill, F. E. Weymouth, A. J. Wiley, W. M. Reed.
Apr. 6, 1912	Sand cement plant	L. C. Hill, W. M. Reed, H. J. Gault, R. R. Coghlan.
Aug. 7, 1912	Design of dam and construction specifications.	A. P. Davis, D. C. Henny, L. C. Hill, E. H. Baldwin, W. M. Reed, F. Teichman.
Feb. 4–5, 1913	Gate control of reservoir	D. C. Henny, O. H. Ensign, L. C. Hill, F. Teichman.
May 27, 1913	Supplemental report on gate control of reservoir.	D. C. Henny, L. C. Hill, F. Teichman.
Dec. 5–6, 1913	Earth embankment	Gen. Wm. L. Marshall, D. C. Henny, W. W. Follett, L. C. Hill, F. Teichman.
Feb. 26, 1914	Methods of construction	A. P. Davis, L. C. Hill, E. H. Baldwin.
Oct. 20, 1914	Earth embankment	Gen. Wm. L. Marshall, D. C. Henny, L. C. Hill, E. H. Baldwin.

OPERATION AND MAINTENANCE.

The Leasburg Dam, Leasburg Canal, and Franklin Canal were operated the entire year. During the latter part of 1915 the Mesilla West Side and the Mesilla East Side Canals were completed, and since the first of the calendar year 1916 these canals have been operated. Early in 1916 the Mesilla diversion dam was completed and the Leasburg Extension Canal built; they were put in operation in time for the season's irrigation.

The Elephant Butte Dam was also operated during the entire year and stored water was delivered not only to the canal systems operated by the United States but also to all community canals having independent headings in the Rio Grande below Elephant Butte.

In 1915 there was irrigated from the canals operated by the Reclamation Service a total of 33,876 acres. The average duty of water on the project varied from an average of 7 acre-feet per acre in the Mesilla Valley to 4.5 acre-feet per acre in the El Paso Valley. The average for the project was 5.9 acre-feet per acre measured at point of delivery from canal.

In the season of 1915 all water delivered in New Mexico under contract between the United States and the Elephant Butte Water Users' Association was on an acre-foot basis. Water is delivered under a similar contract during season of 1916 with the exception that the acre-foot basis has been eliminated. The 1915 water delivery in the El Paso Valley was made under individual rental contracts on the acre-foot basis, and in 1916 under individual and community rental contracts on the same basis.

In 1916 there is being irrigated under the canals operated by the service a total of 61,000 acres which, up to June 30, had used a total of 283,692 acre-feet of water.

The climatic conditions in 1915 were favorable for crop production, and the supply of water was abundant. Insect pests, fungous diseases, waterlogging, and poor farming methods reduced the average crop production per acre considerably. The early part of 1916 was characterized by extremely dry and hot weather with excellent crop yield and good markets. Lack of drainage will reduce crop yields to a considerable extent.

Historical review, Rio Grande project.

Item.	1911	1912	1913	1914	1915	1916[1]
Acreage for which the service was prepared to supply water	26,000	25,000	35,000	40,000	45,000	88,000
Acreage irrigated	25,980	23,115	27,723	28,442	33,876	61,000
Miles of canal operated	6	6	37	37	37	72.3
Water diverted (acre-feet)[2]	152,685	125,000	149,610	179,964	199,952	484,000
Water delivered to land per acre irrigated (acre-feet)[2]	6.00	5.40	4.34	5.68	5.90	7.90

[1] Data for 1916 estimated.

[2] At point of delivery from main canals. Does not include silting and scouring water delivered free of charge.

SETTLEMENT.

An abundance of water in the Elephant Butte Reservoir, insuring a sufficient irrigation supply, has caused a number of property owners who heretofore have allowed their lands to lie idle to clear the land and put it in cultivation. Some of the large holdings are being subvided and sold in comparatively small tracts.

To encourage the settlement of the land by practical farmers a publicity bureau has been maintained. Prior to 1915 this bureau was maintained jointly by the El Paso Valley and the Elephant Butte Water Users' Associations. During the year 1915 the Elephant Butte Water Users' Association established a separate office at Las Cruces, N. Mex., for the cooperative selling of lands in the New Mexico portion of the project. A secretary of immigration is employed and also a land sales agent. Lands are listed for sale and considerable project information distributed through this office.

All the towns on the project have grown steadily. El Paso, especially, is growing fast, and large building operations are carried on during the entire year.

Settlement data, Rio Grande project.

Item.	1913	1914	1915	1916[1]
Total number of farms on project	1,784	1,536	1,700	2,000
Population	6,947	6,642	10,000	11,000
Number of irrigated farms	1,784	1,536	1,700	2,000
Operated by owners	1,089	932	1,000	1,200
Operated by tenants	695	604	700	800
Population	6,947	6,642	10,000	11,000
Number of towns	27	25	25	25
Population	74,918	78,135	80,000	81,000
Total population in towns and farms	81,865	84,777	90,000	92,000
Number public schools	47	47	52	55
Number churches	76	81	85	92
Number of banks	14	14	19	20
Total amount of capital stock	$2,580,000	$2,645,000	$3,251,000	$3,275,000
Total amount of deposits	$10,398,000	$11,653,000	$19,916,380	$26,002,000
Total number of depositors	40,000	45,784	48,090	51,000

[1] Estimated.

PRINCIPAL CROPS.

Alfalfa is the principal crop on the project; about two-thirds of the acreage irrigated is planted to this crop. An excellent crop was raised in 1915, but the price was comparatively low, averaging $10 per ton. A fair crop was cut before June 30, 1916, and a considerable amount sold at a much higher price, averaging $14 per ton. Fruit, apples and pears especially, made excellent returns and proved very profitable, peaches alone excepted. While the peach crop was excellent, there was practically no market, and a considerable amount of the crop was allowed to rot on the trees. Garden truck, sweet potatoes, and grain made fair crops.

Crop report of irrigated lands under Government canals, Rio Grande project, New Mexico-Texas, year of 1915.

Irrigated crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	22,152	Tons	70,080	3.16	$10.00	$700,800	$31.60
Apples	166	Pounds	332,000	2,000.00	.02	6,640	40.00
Barley	193	Bushels	4,594	23.80	.65	2,986	15.47
Beans	448	...do	3,899	8.70	2.40	9,357	20.88
Beets, sugar	1	Tons	10	10.00	5.00	50	50.00
Cane	82	...do	277	3.38	5.00	1,385	16.90
Corn, Indian	3,718	Bushels	101,013	27,17	1.00	101,013	27.17
Corn, fodder	879	Tons	12,593	14.33	3.50	44,075	50.16
Cantaloupes	105	Crates	21,000	200.00	.90	18,900	180.00
Fruits, small	132	Pounds	283,626	2,148.68	.06	17,017	128.92
Garden	1,147					86,025	75.00
Hay	20	Tons	47	2.35	10.00	470	23.50
Oats	771	Bushels	51,094	66.27	.50	25,547	33.14
Onions	7	...do	96	13.24	2.50	240	33.10
Pasture	845				5.00	4,225	5.00
Peaches	121	Pounds	268,983	2,223.00	.01	2,689	22.23
Pears	246	...do	567,030	2,305.00	.025	14,175	57.63
Peas	3	Bushels	38	11.69	3.36	127	39.28
Sweet potatoes	158	...do	14,602	92.42	.40	5,840	36.97
Wheat	2,009	...do	60,605	30.17	1.00	60,605	30.17
Alfalfa seed	29	...do	145	5.00	8.40	1,218	42.00
Less duplicated areas	986						
Total cropped acreage	32,246	Total and average				1,103,388	34.22

Irrigated crop.	Area (acres).	Areas.	Acres.	Farms.
Irrigated, no crop:				
Nonbearing orchards	1,260	Total irrigated area farms reported	33,876	1,092
Young alfalfa	18	Under rental contracts	33,876	1,092
Miscellaneous	351	Total cropped area farms reported	32,246	1,092
Grand total irrigated	33,876			

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 724.]

Feature costs of Rio Grande project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys:		
Project general	$76,355.65	
High-line canal	37,419.31	
Silt deposits Elephant Butte Reservoir	808.59	
Hydrographic surveys, New Mexico	5,525.01	
Hydrographic surveys, Colorado	15,350.48	
Drainage investigations, San Luis	7,262.19	
San Marcial investigations	1,781.25	
Administration and general expense	29.54	
		$144,532.02
Canal system:		
Palomas system, preliminary	1,416.48	
Rincon system, preliminary	8,919.52	
Leasburg system—		
Preliminary	29,342.29	
Leasburg Diversion Dam	92,069.54	
Leasburg Canal	86,495.39	
Leasburg Extension Canal	40,210.02	
Picacho Branch Canal	8,507.35	
Mesilla system—		
Diversion Dam	126,114.65	
st Side Canal	263,204.46	
t Side Canal	121,982.39	

Feature costs of Rio Grande project to June 30, 1916—Continued.

Features.	Subfeature.	Principal feature.
Canal system—continued.		
El Paso system—		
Preliminary	$144,749.01	
Franklin Canal	305,157.24	
San Elizario Feed Canal	23,879.83	
Administrative and general expense	8,428.52	$1,261,166.64
Lateral system:		
Leasburg system, preliminary	3,927.80	
Mesilla west side, preliminary	3,971.48	
Mesilla east side, preliminary	4,496.36	
El Paso system—		
Preliminary	4,395.60	
Bovee lateral	1,455.53	
Administrative and general expense	75.25	18,322.02
Drainage system:		
Project as a whole, preliminary	153.21	
Palomas system, preliminary	18.99	
Leasburg system, preliminary	4.31	
Mesilla system—		
Preliminary	11,467.05	
East River drain	4,803.81	
El Paso system—		
Preliminary	10,572.08	
Mesa drain	4,065.06	
Administrative and general expense	3,457.02	34,541.53
Flood protection:		
Project as a whole, preliminary	271.11	
Palomas system	33.01	
Leasburg system—		
Preliminary	842.86	
Cut-off in river channel	12,966.47	
Mesilla system—		
Mesilla system, general	2,599.29	
Mesilla West Side Canal	1,485.25	
El Paso system, preliminary	10.88	
Administrative and general expense	105.23	18,264.10
Farm units:		
Project as a whole	1,946.80	
Palomas system	3,352.33	
Rincon system	20,855.02	
Leasburg system	14,530.50	
Mesilla system	52,405.21	
El Paso system	27,962.01	121,051.87
Permanent improvements and land:		
Leasburg system—		
Buildings	3,031.66	
Roads	10,062.92	
Mesilla system—		
Buildings	1,333.82	
Roads	1,469.04	
El Paso system, buildings	1,357.00	
Administrative and general expense	627.45	17,881.89
Telephone lines:		
Leasburg system	1,394.11	
Mesilla system	8,713.70	
El Paso system	167.83	
Administrative and general expense	53.73	10,329.37
Operation and maintenance during construction (water-rental basis)		151,133.53
Plant accounts		38,701.08
Gross cost of construction on project to June 30, 1916		1,815,927.05
Less revenues earned during construction period:		
Rental of buildings	828.74	
Rentals of irrigation water	212,453.25	
Contractor's freight refunds	2,156.77	
Loss on mess-house operations	[1] 3,063.11	
Profit on mercantile store operations	666.03	
Profit on hospital operations	7,926.43	220,968.11
Net cost of construction of project to June 30, 1916		1,594,958.94

[1] Deduct.

Feature costs of Elephant Butte storage to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examinations and surveys		$1,447.06
Storage system:		
Preliminary and general work	$397,020.70	
Elephant Butte Dam	4,251,070.11	
Embankment	129,946.04	
Spillway	124,457.87	
		4,902,494.72
Power system (transmission lines)		1,266.83
Permanent improvements and land (roads)		26,655.85
Gross cost of construction of project to June 30, 1916		4,931,864.46
Less revenues earned during construction period:		
Rental of buildings	32,332.17	
Rentals, power, and light	2,243.33	
Contractors' freight refunds	2,213.66	
Forfeitures by defaulting bidders and contractors	5,313.43	
Other revenues, unclassified	584.34	
Loss on mess-house operations	[1] 233.07	
Profit on mercantile store operations	86,413.19	
Loss on hospital operations	[1] 8,377.91	
Plant accounts	19,997.07	
		75,821.87
Net cost of construction of project to June 30, 1916		4,856,042.59

[1] Deduct.

Estimated cost of contemplated work, Rio Grande project, during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examination and surveys, miscellaneous Hydrographic work and silt determination in river		$2,500.00
Canal systems:		
Percha Diversion Dam (Rincon system)	$140,000.00	
Rincon Canal system	163,000.00	
Leasburg system	21,800.00	
El Paso Valley system	59,000.00	
		383,800.00
Lateral system, preliminary work		3,000.00
Drainage system:		
Mesilla Valley main drains	70,000.00	
El Paso Valley main drains	64,155.00	
		134,155.00
Farm units, miscellaneous work		1,000.00
Permanent improvements and land, gate tender's house at Percha Dam		1,000.00
Operation and maintenance during construction (water-rental basis)		94,545.00
Messes		9,450.00
Mercantile stores		3,550.00
Hospitals		4,000.00
Total		637,000.00

Estimated cost of contemplated work, Elephant Butte storage, fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examination and surveys, silt deposits	$7,000	$7,000
Storage system		10,600
Permanent improvements and land (roads)	200	200
Messes		1,300
Mercantile stores		3,800
Hospitals		650
Total		23,550

NORTH DAKOTA, NORTH DAKOTA PUMPING PROJECT.

W. S. ARTHUR, acting project manager, Williston, N. Dak.

LOCATION.

County: Williams.

Townships: 152 to 155 N., Rs. 100 to 104 W., fifth principal meridian.

Railroad: Great Northern.

Railroad stations and estimated population January 1, 1916: Buford, 75; Trenton, 150; and Marley (less than 25). On Buford-Trenton unit are small unincorporated villages. Williston, on the Williston unit, is an incorporated city of about 4,500 population.

WATER SUPPLY.

Source of water supply: Missouri River.

Area of drainage basin: 155,000 square miles.

Mean run-off of Missouri River, near Williston, May to October, 1905 to 1907: 15,000,000 acre-feet.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season 1916: Buford-Trenton unit, 4,049 acres; Williston unit, 8,189 acres.

Area under water-right applications and water rental contracts to June 30, 1916: 5,706.48 acres.

No part of the project was irrigated in 1915. The Williston unit is being operated for commercial power, under a contract with the city of Williston.

Length of the irrigation season: 80 days, beginning from June 1 to June 15.

Average elevation of the irrigable area: 1,900 feet above sea level.

Rainfall: The actual precipitation, calendar year 1915, was 13.87 inches. The average for 12 years, beginning in 1904, was 13.51 inches.

Range of temperature on the irrigable area: —49° to 107° F.

Character of soil on irrigable area: Ranges from sandy loam to heavy clay gumbo.

Principal products: Alfalfa, grains, vegetables. The production of corn for silage is increasing as well as the output of hogs, and dairying has become well established.

Principal markets: St. Paul, Minneapolis, Duluth, Chicago. The local market is now important since it consumes all of the butter product and all of the output from the dairies.

LANDS OPENED FOR IRRIGATION.

Dates of public notices and orders: Buford-Trenton unit, April 8, 1908; March 9, 1911; May 13, 1911; June 25, 1912; July 15, 1913; February 26, 1914; March 7, 1914. Williston unit, April 27 and November 30, 1908; April 30, 1909; March 9 and April 14, 1911; June 25, 1912; March 11, 1913; June 23, 1913; July 15, 1913; July 21, 1913; February 26, 1914; March 7, 1914.

Location of lands opened: Buford-Trenton unit, Tps. 152 and 153 N., Rs. 103 and 104 W., fifth principal meridian; Williston unit, Tps. 154 and 155 N., Rs. 100 and 101 W., fifth principal meridian.

Present status of irrigable lands: Buford-Trenton unit, 249 acres entered subject to reclamation act; 212 acres open to entry; 91 acres of State lands; 3,420 acres in private ownership. Williston unit, 54 acres entered subject to the reclamation act; 320 acres open to entry; 67 acres of State land; 7,707 acres in private ownership.

Limit of area of farm units: Public, 80 acres; private, 160 acres.

Duty of water: Two acre-feet per acre per annum at the farm.

Building charge per acre of irrigable land: $38 under public notice of 1908.

Annual operation and maintenance charge: 70 cents per acre of irrigable land and 50 cents per acre-foot of water actually used, under public notices of 1908; $1.50 per acre of irrigable land and $1 per acre-foot of water used under order of May 13, 1911. For season of 1914 the project was on a rental basis and the terms were $1 per acre, including 1 acre-foot of water, and $1 per acre-foot for water delivered in excess of 1 acre-foot per acre.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys begun in 1903.

Construction recommended by board of engineers September 22, 1905.

Construction authorized by Secretary January 23, 1906.

First division: Buford-Trenton unit, completed November, 1907.

Power and pumping plants: Williston unit, completed for present use in the fall of 1907; first division completed in the spring of 1908.

Pumping plant and transmission lines: Buford-Trenton unit, completed for present use in the spring of 1908.

First irrigation by Reclamation Service, season of 1908.

Power installation completed for 2,000 horsepower June 30, 1910.

Buford-Trenton unit, 38 per cent completed June 30, 1915; Williston unit, 64 per cent completed June 30, 1915.

Entire project, 64 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the North Dakota pumping project provides for a central steam power plant located near Williston, operating pumps and generating electricity for the operation of other pumps on the Buford-Trenton and Williston units. On the Buford-Trenton unit water is pumped from a barge into a settling basin 30 feet above the river, and is then lifted by a permanent pumping station into a canal, 50 feet above the settling basin, for the irrigation of bench lands near Buford. A transmission line 28.3 miles in length delivers power for the operation of the pumps. The plan of the Williston unit provides for a series of motor-driven centrifugal pumps on a barge in the Missouri River, a settling basin receiving the water from the barge, and a main canal of 90 second-feet capacity extending along Little Muddy Creek to the power plant, where two sets of steam-driven turbines operate centrifugal pumps to lift water 51 feet into E Canal. From the main canal, about midway between the river and the power plant electrically driven pumps raise 35 second-feet 28 feet into B Canal, and from the B Canal 20 second-feet are raised an additional 28 feet into C Canal. The main power station is located close to a 9-foot vein of lignite coal, from which fuel is obtained.

The United States claims all waste, seepage, spring, and percolating water arising within the project, and proposes to use such water in connection therewith.

The features of the above irrigation plan which have been completed are: The central power station, coal mine and transmission lines; at Buford-Trenton unit, two pumping stations, settling basin, and canal system; at Williston unit, four pumping stations, two settling basins, and canal system. No construction work is in progress at present.

Features remaining for future construction are: The enlargement of the power house and installation of additional machinery; at Buford-Trenton unit, extension of Highline Canal and construction of Lowline Canal and laterals for irrigation of bottom lands; at Williston unit, construction of east and west bottom canal systems, with additional intake and pumping stations.

SUMMARY OF GENERAL DATA FOR NORTH DAKOTA PUMPING PROJECT TO JUNE 30, 1916.

Areas:		
Irrigable acreage when project is complete		26,273
Public land entered, June 30, 1916	303	
Public land open to entry, June 30, 1916	532	
Public land withdrawn, June 30, 1916	78	
State land, June 30, 1916	1,073	
Private land, June 30, 1916	24,287	
Acreage service could have supplied season of 1915		12,239
Estimated acreage service can supply, July 1, 1917		12,239

Finances:			
Estimated cost of completed project			$1,149,880.25
Total construction cost to June 30, 1916			$739,880.25
Per cent complete, June 30, 1916			64
Appropriations for fiscal year 1917, total			$50,000.00
Estimated per cent complete, June 30, 1917			64
Announced construction charges per acre			$38.00
Appropriation, fiscal year 1916			$25,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$17,624.16		
Transfers	2,163.98		
		$19,788.14	
Registered liabilities chargeable to 1916 appropriation		1,799.84	
			21,587.98
Unencumbered balance, July 1, 1916			3,412.02
Repayments:			
Construction charges—			
Accrued to June 30, 1916			47,541.24
Collected to June 30, 1916			7,631.87
Uncollected, June 30, 1916			39,909.37
Operation and maintenance charges (public notice)—			
Accrued to June 30, 1916			24,340.51
Collected to June 30, 1916			13,025.88
Uncollected, June 30, 1916			11,314.63
Water rental charges—			
Accrued to June 30, 1916			2,768.35
Collected to June 30, 1916			1,946.78
Uncollected, June 30, 1916			821.57
Power earnings—			
Accrued to June 30, 1916			75,320.95
Collected to June 30, 1916			73,145.95
Uncollected, June 30, 1916			2,175.00
Drainage:			
Miles of drains built to June 30, 1916; open			12.7
Expended to June 30, 1916, on drainage works completed and uncompleted			$3,546.95

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

BUFORD-TRENTON UNIT.

Pumping plants.—There are two pumping plants on the project. The intake pumping station is installed on a barge, which, during the irrigation season, is moored in Missouri River and contains four pumping units designed to take water from the river and deliver it through riveted steel discharge pipes provided with flexible joints into a settling basin adjacent to the river and extending to the second pumping station. Station 2 contains four pumping units designed to take water from the settling basin through a horizontal suction pipe and to discharge it into a riveted steel pipe connected to a concrete-steel pipe leading to a high-line canal. Electric power for the operation of the pumping stations is delivered from the Williston unit over a transmission line to a bank of transformers located in station 2. The intake pumping station was constructed by Government forces. Pumping station 2, a concrete structure 63 feet 8 inches by 19 feet 8 inches in plan and about 27 feet in height, was constructed under a contract dated March 26, 1907. Proposals for the construction of this station were opened on March 5, 1907. The equipment for the two stations was furnished under contract dated September 27, 1906. Proposals for the furnishing of this machinery were opened on September 10, 1906. The buildings for the plants were completed and machinery installed in 1907. The transmission line was constructed by Government forces, being completed in the spring of 1908.

Canals and structures.—Proposals for the construction of canals and structures were opened September 11, 1906. But one proposal was received and this was considered excessive and was rejected. A readvertisement was made and proposals were opened on March 5, 1907. The work covered by the specifications was divided as follows: Division A, structures such as bridges, culverts, turn-outs, drops, flumes, and all excavation and embankment required for the high-line canal and laterals and the waste-water ditches on bench lands; division B, similar work required for the low-line canal; division C, the building and furnishing of the pressure pipe leading from pumping station 2 to the high-line canal; division D, the construction of pumping station 2. A contract for division A was entered into on March 26, 1907, and the work of construction was completed in November of the same year. A contract for division B was entered into on May 21, 1907, and the work of construction was completed in September, 1907. A contract for division C was entered into on March 22, 1907, and the work under this contract was completed in October of that year. The contract for division D was dated March 26, 1907, and the work under it was completed in 1907. A contract for constructing the embankment for the settling basin was executed May 21, 1907, and the work was completed the following September.

No construction has been carried on since July 1, 1910.

WILLISTON UNIT.

Power for the Williston unit is developed in a main power plant designated as station 1, situated about 3 miles north of Williston and close to a lignite coal mine owned and operated by the Reclamation Service. The intake pumping station, known as station 3, is located on a barge moored in Missouri River during the irrigation season. This station is equipped with three pumping units consisting of centrifugal pumps of 30-second-foot capacity under a head of 30 feet, direct connected to 3-phase, 2,200-volt motors. Water is pumped from the intake to a settling basin through discharge pipes with flexible metallic joints. Pumping station 2 is located on the main canal 1 mile from the intake and contains two electrically operated pumping units. Station 4 is located on the high-line canal about 1 mile from station 2 and contains one electrically operated pumping unit. Pumping station 1 is located at the end of the main canal; is built in connection with the power plant, and contains two steam-turbine pumping units. Three circulating pumps supply water to two surface condensers and one jet condenser, and the water, after passing through the condensers, may be discharged into a canal 26 feet above the supply canal or may be returned to the equalizing reservoirs. Stations 2 and 4 are operated with current at 220 volts. Proposals for the construction and equipment of the pumping plants were opened on August 14, 1906. The specifications included the following schedules: Schedule A, boiler plant at power station; schedule B, steam-operated pumps at power station; schedule C, electric generating plant at power station; schedule D, transformers, motors, and pumps for station 2; schedule E, transformers, motors, and pumps for station 3; schedule F, 3 miles of transmission line; and schedule G, building for the power station. The work for schedules A, B, C, D, E, and G was let in three contracts, and the transmission line, schedule F, was built by Government forces. All the work was completed by the fall of 1907.

Proposals for the construction of about 80 miles of canals and laterals, composing the distribution system, and the appurtenant structures, including 2 pumping stations, pressure pipes, 2 canal siphons, 2 canal flumes, bridges, culverts, and turn-outs, were opened on August 30, 1906. The work was let in one contract dated September 26, 1906, and the construction was completed early in 1908.

No construction work has been carried on since July 1, 1910.

SEEPAGE AND DRAINAGE.

There is a small seeped or water-logged area on the project aggregating 336.76 acres; 289.29 acres lie in the flat or bottom lands of the Little Muddy and 57.46 acres on higher ground in section 12, just north of Williston.

The present condition of the affected areas is due in very small degree to irrigation. Many of these tracts were water-logged before the canals were constructed, and their condition now is not much worse than it has been for many years. The construction of waste drains has undoubtedly relieved some of the areas. While the duty of caring for water drains has been put upon the water users, they have not shown much energy in keeping them clear of obstruction. Where drains have been constructed by the United States to the boundaries of tracts, owners have seldom carried the cuts across their lands to avail themselves of the opportunity for drainage.

In connection with the work of the Board of Review an examination of the drainage conditions of the project was made by the drainage engineer in August, 1915. The examination was necessarily somewhat cursory, because of the limit of time, but the report was in substance as herein stated, with the additional estimate that $50,000 would be the ultimate cost of a system satisfactorily to drain the entire irrigable acreage of the Williston unit. No expenditure for drainage will be necessary, however, until more extensive irrigation has developed the ultimate requirements.

ECONOMIES OF GOVERNMENT WORK.

Coal mine.—The feasibility of irrigation in North Dakota is largely dependent upon fuel supply, since no gravity projects are to be found and fuel must necessarily be one of the largest factors of cost in a pumping project where power is generated from steam.

In the fifth annual report it was assumed that "the total cost per ton delivered at the plant will be about $1.25, allowing for maintenance of mining plant and tramway." This is practically the average cost of coal mined by private enterprise in this section where the demand has been more or less definitely determined and mines are operated continuously. Plants purchasing their fuel pay $2.20 to $2.50 delivered.

The coal mine operations have been conducted at a great disadvantage, especially during the first five years. To be prepared for the estimated demands of the irrigation seasons, a large initial development was necessary. The erratic and indefinite requirements resulted in expensive upkeep and difficulty in securing a competent mine force. A very faulty roof made excessive timbering costs. It was difficult to get away from the "country bank" methods of mining pursued by local coal mines.

During the period of commercial power operations there has been some output of coal in every month and a gradual reduction of cost has been effected. A more systematic plan of operation has been followed, looking to a reduction in development to be maintained, the continuous employment of a smaller force, and other economies. The result has been the reduction of unit cost for the total output from $1.89 to December 31, 1912, to $1.599 to June 30, 1916. The unit cost for the fiscal year 1916 was $1.115. This cost for an average output of 24 tons per day makes a very favorable comparison with the average costs of the district (approximately $1.25) for an average output of 80 to 100 tons per day. It is expected that there will be a larger consumption of coal in the fiscal year 1917 and that the record as to unit costs will be further improved. It is readily seen that if plant and coal mine were operated to full capacity costs would compare favorably with those of the largest operations in the country.

COMMERCIAL POWER.

A contract with the city of Williston, dated October 16, 1912, covering the delivery of surplus electrical energy from the power plant, was in force, and some portion of the plant was in operation the entire year to furnish energy in compliance with this contract. Some conditions of the contract, particularly the minimum load requirement, were made effective March 1, 1916, by a revision of the contract. These changes insure an increased profit from the contract, the upkeep of existing works, and a reduction in the investment of the United States during periods of nonirrigation, and give promise of successful irrigation operations with the cooperation which the water users may expect to effect.

During the year 699,050 kilowatt-hours of electrical energy were delivered to the city switchboard. This was an increase of 167,200 kilowatt-hours or 31.4 per cent over the commercial service for the previous year. During this period five interruptions occurred of 10, ½, ½, 30, and 2 minutes, respectively. The 10-minute and 30-minute interruptions were by the request of the city to admit of repairs, and the three shorter interruptions were due to circuit breaker opened on account of lightning. The following is a statement of the results of the operation of the contract for the fiscal year:

Sale of commercial power, North Dakota pumping project.

Year and month.	Cost.		Collections.		Profit.	
	This month.	Total to date.	This month.	Total to date.	This month.	Total to date.
1915.						
July	$1,751.74	$50,396.43	$1,901.25	$51,162.45	$149.51	$766.02
August	1,811.67	52,208.10	2,143.75	53,306.20	332.08	1,098.10
September	1,793.75	54,001.85	2,066.25	55,372.45	272.50	1,370.60
October	1,876.83	55,878.90	2,132.50	57,504.94	255.67	1,626.05
November	2,146.96	58,025.86	2,265.00	59,769.95	118.04	1,744.09
December	2,304.66	60,330.52	2,414.00	62,183.95	109.34	1,853.43
1916.						
January	1,717.77	62,048.29	2,307.00	64,490.95	589.23	2,442.66
February	1,992.38	64,040.67	2,130.00	66,620.95	137.62	2,580.28
March	2,628.87	66,669.54	2,175.00	68,795.95	[1] 453.87	2,126.41
April	2,038.03	68,707.57	2,175.00	70,970.95	136.97	2,263.38
May	2,070.21	70,777.78	2,175.00	73,145.95	104.79	2,368.17
June	1,829.09	72,606.87	2,175.00	75,320.95	345.91	2,714.08

[1] Loss.

In addition to the above gain the contract returned during the fiscal year $684.46 of the cost of preparing the plant for winter operation, $1,045.62 plant depreciation and plant arbitrary charges, and $918.01 cost of the board of review, a total of $2,648.09.

At the close of the fiscal year some new motor installations are being made, a cooking rate becomes effective and a new city lighting system is nearing completion. These changes will have an almost immediate effect upon the load. The water users and city officials hope that the increase in the power load and earnings will be sufficient, after properly caring for depreciation charges, together with the payment which the water users will be able to make, to secure the operation of the project in the following fiscal year.

OPERATION AND MAINTENANCE.

During the fiscal year 1916 the power plant, coal mine, and transmission line to Williston were operated. Maintenance necessary to the proper upkeep of all public property was conducted. The water users were unable to comply with the requirements of the Reclamation Commission that they operate the irrigation system on their own account or guarantee the full repayment of the operation and maintenance cost at the close of the irrigation year; therefore the pumping barges were not launched and no irrigation operations were conducted. The repayment of the irrigation costs each year is required by the reclamation extension act. In the spring of 1916 the water users estimated that they would be able to accomplish this, but the Reclamation Commission considered the estimate not ample and required guarantee, deposit, or assurance against loss, which the water users were unable to give.

Until practically all the irrigable lands of the Williston unit are settled and prepared for irrigation the ability of the project to return the operation and maintenance costs each year will depend upon the profit derived from operations covered under the title "Commercial power." As a result of increases to be made in the power load early in the fiscal year 1917 the water users believe they will be able to make the Williston unit self-supporting.

Due to nonirrigation in 1915 alfalfa stands suffered and there was a serious shortage of hay in the winter of 1915–16, which was unusually severe; considerable loss of live stock resulted.

Historical review, North Dakota pumping project.

WILLISTON UNIT.

	1911	1912	1913	1914	1915	1916
Area for which service was prepared to supply water	8,189.31	8,189.31	8,189.31	8,189.31	8,189.31	8,189.31
Acreage irrigated	2,426.00	323.00	1,739.00	1,056.00	....	....
Number of farms irrigated	77	16	54	44	....	....
Miles of canal operated	37	18	32	30	....	....
Water diverted (acre-feet)	4,299.70	759.32	3,637.74	2,670.83	....	....
Water delivered to land (acre-feet)	2,952.00	278.00	2,287.70	1,791.50	....	....
Water per acre of land irrigated (acre-feet)	1.22	0.66	1.31	1.70	....	....

BUFORD-TRENTON UNIT.

Area for which service was prepared to supply water	4,049.00	4,049.00	4,049.00	4,049.00	4,049.00	4,049.00
Acreage irrigated	1,163.00	....	....	....	....	....
Number of farms irrigated	21	....	....	....	....	....
Miles of canal operated	12.75	....	....	....	....	....
Water delivered to land (acre-feet)	1,472.00	....	....	....	....	....
Water per acre of land, irrigated (acre-feet)	1.27	....	....	....	....	....

SETTLEMENT.

Because of the suspension of irrigation operations, settlement of the project is practically stationary. Some very material improvements in farm property have occurred, notably in better types of farm dwellings, barns, and silos. Two conditions constitute the principal problem to be solved, viz., the reduction of the larger holdings of private irrigable lands and the placing of actual residents upon them, and the resumption of irrigation operations. The conditions are so dependant upon each other that they must be worked out together.

Three farmers' clubs are active upon the project. A cooperative creamery and ice cream factory is operated in Williston, securing its product chiefly from alfalfa-fed cows of the project. There are also a farmers' cooperative elevator and a tannery. Settlement data of the two units of the project are summarized in the following tables.

Settlement data, North Dakota pumping project.

WILLISTON UNIT.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	93	101	101	101	101
Population	172	146	146	163	175
Number of irrigated farms	16	54	26	44	....
Number operated by owners or managers	8	32	18	34	34
Number operated by tenants	8	22	8	10	10
Population	48	162	72	140	152
Number of towns	2	2	2	2	2
Population	4,700	4,700	4,700	5,000	5,000
Population in towns and on farms	4,872	4,846	4,846	5,163	5,175
Number of public schools	4	4	4	5	5
Number of churches	5	5	5	6	6
Number of banks	5	3	3	3	3
Total capital stock	....	....	$135,000	$135,000	$185,000
Total amount of deposits	....	....	....	$1,300,000	$1,500,000
Total number of depositors	....	....	....	3,000	3,300

Settlement data, North Dakota pumping project—Continued.

BUFORD-TRENTON UNIT.

Item.	1912	1913	1914	1915	1916
Total number farms on project	34	38	42	42	42
Population	53	69	70	70	70
Number of irrigated farms	....	....	....	....	....
Number operated by owners or managers	19	10	19	19	19
Number operated by tenants	2	23	23	23	23
Number of towns	2	2	2	2	2
Population	350	350	350	400	400
Total population on farms and in towns	403	419	420	470	470
Number of public schools	1	1	1	2	3
Number of churches	2	2	2	2	2
Number of banks	1	1	1	2	2
Total capital stock	....	....	$10,000	$20,000	$20,000
Amount of deposits	....	....	$100,000	$115,000	$115,000
Number of depositors	....	....	200	240	240

PRINCIPAL CROPS.

Alfalfa continues to be the principal crop. During the severe winter of 1915–16 a large percentage of the alfalfa winter-killed and will probably not be reseeded until irrigation operations are resumed. The acreage in truck has increased. The 1915 crop of potatoes was exhausted early at high prices. Dairying and raising cattle and hogs are now the chief activities on the project. Since no lands were irrigated no crop-yield report was made.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 726.]

Feature costs of North Dakota pumping project to June 30, 1916.

Features.	Sub-feature.	Principal feature.
Examination and surveys	....	$44,969.88
Lateral system:		
Williston unit	$141,292.90	
Buford-Trenton unit	58,406.83	199,699.78
Power system:		
Williston unit—		
Coal mine	14,224.61	
Williston barge	39,647.14	
Williston transmission line	16,439.30	
Pumping substation B	8,281.60	
Pumping substation A	14,065.76	
Power house	176,803.30	
Transformer station at barge	2,742.19	
Floating boom at barge	772.64	
Scow pontoon	1,411.83	
Buford-Trenton unit—		
Buford-Trenton transmission line	25,345.99	
Buford-Trenton barge	36,583.53	
Pumping substation A	36,127.77	
Boom and scow pontoon	787.60	
Extension to Williston power house	76,329.36	449,562.12
Permanent improvements and lands:		
Williston unit	17,606.46	
Buford-Trenton unit	5,850.13	23,456.59
Operation and maintenance charges transferred to and compounded with construction charges	....	22,191.98
Gross cost of construction of project to June 30, 1916	....	739,880.25
Less revenues earned during construction period:		
Rentals of buildings	347.16	
Rentals of irrigating water	196.75	
Contractors' freight refunds	5,495.08	6,038.99
Net cost of construction of project to June 30, 1916	....	733,841.26

Estimated cost of contemplated work, North Dakota pumping project, during fiscal year 1917.

Features.	Sub-feature.	Principal feature.
Operation and maintenance under public notice	....	$37,224.00
Messes	....	690.00
Mercantile stores	....	1,960.00
Hospitals	....	126.00
Total	....	40,000.00

OKLAHOMA, LAWTON PROJECT.

C. T. PEASE, project manager, Lawton, Okla.

LOCATION.

County: Comanche.

Townships: 2 and 3 N., Rs. 12 and 13 W., Indian meridian.

Railroads: St. Louis & San Francisco; Chicago, Rock Island & Pacific.

Railroad station and estimated population, January 1, 1915: Lawton, Okla., 8,000.

WATER SUPPLY.

Source of water supply: Medicine Bluff and Little Medicine Bluff Creeks.

Area of drainage basin: 110 square miles.

Annual run-off in acre-feet of Medicine Bluff and Little Medicine Bluff Creeks at site of proposed diversion dam: Medicine Bluff Creek, including the run-off of Little Medicine Bluff Creek and the overflow from Lake Lawtonka, supplied by Medicine Bluff Creek, 1915, 33,405 acre-feet. The estimated natural run-off of Medicine Bluff Creek is 20,700 acre-feet, which includes the run-off at the proposed diversion dam plus the amount of water used by the city of Lawton and Fort Sill and the evaporation on the reservoir.

Reservoir: Storage capacity of top 20 feet of Lake Lawtonka, which was built by the city of Lawton, Okla., for domestic use. The reservoir has a total capacity of 14,000 acre-feet and covers an area of 1,082 acres. The reservoir is formed by a 50-foot masonry dam, which stores the waters of Medicine Bluff Creek, and it is estimated that the capacity of the top 20 feet, which the city of Lawton agreed to donate to the Government, is 12,000 acre-feet.

Irrigable area: Approximately 2,500 acres under present plan.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Length of irrigation season: April 1 to October 31—214 days.

Average elevation of irrigable area: 1,100 feet above sea level.

Rainfall on irrigable area: 30 years, average, 31 inches; at Lawton, Okla., 1915, 39.8 inches.

Range of temperature on irrigable area: 10° to 110° F.

Character of soil on irrigable area: Clay loam; rolling.

Principal products: Garden truck, melons, tomatoes, cabbage, onions, sweet potatoes, berries, fruit, forage crops, and cotton.

Principal markets: Lawton and Oklahoma City, Okla.; Kansas City and St. Louis, Mo.; Galveston, Tex.; and New Orleans, La.

CHRONOLOGICAL SUMMARY.

Reconnoissance authorized by secretary April 29, 1912.

Reconnoissance begun June 12, 1912.

Gauging stations were established at Lake Lawtonka and on Little Medicine Bluff and Medicine Bluff Creeks during the summer of 1912 and an evaporation raft placed on Lake Lawtonka. Arrangements were made with the United States Geological Survey to rate the streams and keep records of rainfall, evaporation, and run-off. An automatic gauging station was placed in Medicine Bluff Creek in the winter of 1914.

An allotment of $100,000 was approved by the Secretary of the Interior on January 24, 1914, for the construction of the project under certain conditions. These included the formation of an acceptable water users' association, the subscription of about 1,900 acres of irrigable land in a compact body close to the

600 acres of Indian school land to be included, and agreement for division of holdings into small farms.

On August 1, 1914, an act of Congress was passed authorizing the inclusion of 600 acres of Indian school land in the project.

An office was opened at Lawton, Okla., and surveys begun in August, 1914, by Mr. P. M. Fogg, engineer, and continued to February, 1915, when work was discontinued.

In October, 1914, a soil examination was made of the irrigable area of the project. The resultant report was favorable as to the effect of irrigation on the soils.

During the calendar year 1915 the water users' association secured subscription of stock covering 1,800 acres of land, but the tracts subscribed did not form a sufficiently compact body to permit economical irrigation.

Early in 1916 it was determined to form an irrigation district under the laws of Oklahoma and enter into a contract for the construction of irrigation works to serve approximately 2,500 acres of private lands.

The office at Lawton was reopened May 15, 1916.

IRRIGATION PLAN.

The irrigation plan for the Lawton project provides for the storage of the water of Medicine Bluff Creek in the Lawton Reservoir, or Lake Lawtonka, the top 20-foot capacity of which has been donated to the Government by the town of Lawton for this use, and the direct diversion of the water of Little Medicine Bluff Creek, a diversion dam in Medicine Bluff Creek and distribution of the water through a canal approximately 7 miles long, irrigating about 2,500 acres in the vicinity of Lawton, Okla. The area to be irrigated has not been definitely selected at this time, but will be adjacent to about 600 acres of Indian land north of Lawton.

SUMMARY OF GENERAL DATA FOR LAWTON PROJECT, TO JUNE 30, 1916.

Areas:			
Irrigable acreage when project is complete			2,500
Private land, June 30, 1916			2,500
Finances:			
Estimated cost of completed project			$160,000.00
Total construction cost to June 30, 1916			$9,637.64
Per cent complete, June 30, 1916			6
Appropriation for fiscal year 1917, total			$51,000.00
Allotment for construction, fiscal year 1917			$51,000.00
Estimated per cent complete, June 30, 1917			38
Appropriation, fiscal year 1916			$50,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$709.63		
Transfers	231.87		
		$941.50	
Registered liabilities chargeable to 1916 appropriation		643.01	
Unencumbered balance, July 1, 1916			$48,415.49

CONSTRUCTION DURING FISCAL YEAR.

Preliminary surveys.—No field work of any description was done between February, 1915, and June, 1916. During the month of June, 1916, topography was taken of the site for the diversion dam on Medicine Bluff Creek; numerous bench marks were established throughout the area proposed to be irrigated; and a contour survey of the district was commenced.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 728.]

Feature costs of Lawton project to June 30, 1916.

Features.	Sub-feature.	Principal features.
Examination and surveys		$4,669.24
Storage works, Lawton Reservoir		355.18
Canal system:		
Diversion dam	$284.48	
Main canal and structures	2,638.29	
		2,922.77
Lateral system, laterals and irrigable lands		1,699.45
Gross cost of construction of project to June 30, 1916		9,646.64
Less revenues earned during construction period, profit on hospital operations		9.00
Net cost of construction of project to June 30, 1916		9,637.64

Estimated cost of contemplated work, Lawton project, during fiscal year 1917.

Features.	Sub-feature.	Principal features.
Examination and surveys:		
Preliminary work	$1,000.00	
Topographic surveys	1,500.00	
Hydrographic records	600.00	
Canal and lateral surveys	1,200.00	
		$4,300.00
Canal system:		
Diversion dam and headworks	18,500.00	
Main canal	27,200.00	
		45,700.00
Messes		600.00
Mercantile stores		200.00
Hospitals		200.00
Total		51,000.00

OREGON, UMATILLA PROJECT.

H. D. NEWELL, project manager, Hermiston, Oreg.

LOCATION.

Counties: Umatilla and Morrow.

Townships: 4 and 5 N., Rs. 24, 25, 26, 27, 28, and 29 E., Willamette meridian.

Railroads: Oregon-Washington Railroad & Navigation Co.; Northern Pacific.

Railroad stations and estimated population January 1, 1916: Hermiston, 600; Umatilla, 200.

WATER SUPPLY.

Source of water supply: Umatilla River.

Area of drainage basin: 1,610 square miles.

Annual run-off in acre-feet: Umatilla River at Yoakum (1,200 square miles), 1903 to 1915, maximum, 723,000; minimum, 250,000; mean, 504,000.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which Service is prepared to supply water, season of 1916: 19,000 acres.

Area under water-right applications, season of 1916: 14,100 acres.

Length of irrigation season: From March 20 to October 16—210 days.

Average elevation of irrigable area: 470 feet above sea level.

Rainfall on irrigable area: Average, 8.3 inches; 1915, 10.43 inches.

Range of temperature on irrigable area: —28° to 115° F. (ordinary minimum, 0° F.)

Character of soil, irrigable area: Sandy loam.

Principal products: Alfalfa, fruits, berries, vegetables.

Principal markets: Portland, Oreg., and Spokane, Wash.

LANDS OPENED FOR IRRIGATION.

Dates of public notices and orders: December 27, 1907; August 3 and November 12, 1908; April 3, 1909; January 6, 1910 (two); February 28 and May 16, 1911; March 2 and May 8, 1912; March 3, April 7, June 23, July 15, and July 21, 1913; January 19 and September 24, 1914; February 25, April 5, and December 12, 1915 (two); March 16, April 12 (three), May 12, and May 27, 1916.

Location of lands opened: Ts. 4 and 5 N., Rs. 24, 25, 26, 27, 28, and 29 E., Willamette meridian.

Present status of irrigable area opened: 2,830 acres entered subject to reclamation act; 713 acres open to entry; 13,681 acres private land.

Limit of area of farm units: Public, 40 acres; private, 160 acres.

Duty of water: 2.8 acre-feet per acre per annum at the farm.

Building charge per acre of irrigable land: $60, $70, and $92.

Annual operation and maintenance charge: Varying with quantity of water used.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys begun in 1903.

Construction recommended by board of engineers October 27, 1905.

Construction authorized by Secretary December 4, 1905.

Diversion dam and feed canal completed August, 1907.

Cold Springs Dam completed June, 1908.

First irrigation by Reclamation Service season of 1908.

Construction of west extension authorized December 22, 1913.

West Extension (Three Mile Falls) Diversion Dam completed November 28, 1914.

West Extension Main Canal completed June, 1916.

Entire project (including west extension) 79.6 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Umatilla project provides for the diversion of water from the Umatilla River above Echo, Oreg., through a feed canal 24.5 miles long, into a storage reservoir. Water is diverted from the reservoir through an outlet canal, also from the feed canal by means of a by-pass connecting the feed and outlet canals. Water is also diverted from the Umatilla River by the Maxwell Canal, heading near Butter Creek, and delivered into a distribution system from the reservoir, thus watering land in the Umatilla and Columbia River Valleys near Hermiston, Oreg. In addition some 10,000 acres bordering the Columbia River in the vicinity of Umatilla and Irrigon, Oreg., will be watered by a canal diverting from the Umatilla River about halfway between Hermiston and Umatilla.

The United States intends, for and in connection with the project, to use the waste, seepage, spring, and percolating water arising within the same, and asserts a right thereto by virtue of its reservation of all unappropriated waters of the project source of supply and of its appropriation of said waters in accordance with the State law, heretofore made, for the purpose of the project.

The features which have been completed are the diversion works above Echo, feed canal, Cold Springs Dam, by-pass, diversion works for the Maxwell Canal, diversion works for the west extension, main distributary from Cold Springs Reservoir, main distributary for the west extension, and laterals for the irrigable area now opened. Four drain ditches have been built. The main construction work in progress is the building of laterals for the west extension.

SUMMARY OF GENERAL DATA FOR UMATILLA PROJECT TO JUNE 30, 1916.

Areas:			
Irrigable acreage when project is complete			36,301
Public land entered, June 30, 1916		2,830	
Public land open to entry, June 30, 1916		713	
Public land withdrawn, June 30, 1916		4,228	
Private land, June 30, 1916		28,530	
Acreage service could have supplied season of 1915			16,000
Addition in fiscal year, 1916			3,000
Estimated addition in fiscal year, 1917			3,000
Estimated acreage service can supply July 1, 1917			20,000
Acreage actually irrigated, season of 1915			5,306
Acreage cropped under irrigation, season of 1915			3,603
Crops:			
Value of irrigated crops, season of 1915			$104,653.44
Value of irrigated crops, per acre cropped			29.04
Finances:			
Estimated cost of completed project			$3,841,324.78
Total construction cost to June 30, 1916			$2,175,592.24
Per cent complete, June 30, 1916			79.6
Appropriation for fiscal year 1917, total			$235,000.00
Allotment for construction, fiscal year 1917			$180,000.00
Announced construction charges per acre		$60.00,	$70.00, $92.00
Appropriation, fiscal year 1916			$366,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$234,074.23		
Transfers	12,981.06		
		$247,055.29	
Registered liabilities chargeable to 1916 appropriation		29,215.73	
			$276,271.02
Unencumbered balance, July 1, 1916			$89,728.98

Repayments:	
Construction charges—	
Accrued to June 30, 1916	$47,521.38
Collected to June 30, 1916	$28,238.40
Uncollected, June 30, 1916	$19,282.98
Operation and maintenance charges (public notice)—	
Accrued to June 30, 1916	$84,756.64
Collected to June 30, 1916	$69,066.56
Uncollected, June 30, 1916	$15,690.08
Water rental charges—	
Accrued to June 30, 1916	$8,477.94
Collected to June 30, 1916	$8,474.45
Uncollected, June 30, 1916	$3.49
Drainage:	
Estimated acreage damaged by seepage to June 30, 1916	200
Miles of drains built to June 30, 1916, open	10
Estimated acreage protected by drains built to June 30, 1916	2,000
Estimated acreage to be protected by authorized system	2,000
Expended to June 30, 1916, on drainage works, completed and uncompleted	$57,888.48

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

DIVERSION DAM AND FEED CANAL.

The diversion dam at the head of the feed canal is a low concrete weir on crib work 400 feet long. The closure of the river channel is completed by an earth embankment, with rock-fill protection, 8 feet high above the crest of the weir.

Proposals for the construction of the canal and about 1,300 feet of the by-pass canal, together with appurtenant structures, including the diversion dam, headworks, sand gates, regulating weir, railroad crossing, ditch crossings, bridge piers, and by-pass weir, were opened on June 29, 1906. A contract for the work was executed and work was begun on September 1, 1906, and the construction was completed on August 6, 1907. In addition to the work by contract some work on the structures was done by Government forces, and because of excessive seepage 5,800 linear feet of full concrete lining and 3,700 linear feet of side lining were placed in the canal by Government forces during the seasons of 1908 and 1909.

On May 13, 1913, contract was entered into with Joseph Cunha, of Echo, Oreg., whereby in consideration of $10,000 being paid by Cunha certain improvements and enlargements would be made to the feed canal so the water for power purposes could be delivered to Cunha at the Echo Mills. Payment of the $10,000 was promptly made. Over 4,000 feet of the lower bank of the canal were lined with concrete 3 inches thick; the culvert under the railroad track was enlarged. The outside wall of the semicircular conduit was raised 1 foot and a turnout provided. In addition from time to time various stretches of the feed canal have been lined. Since June 30, 1910, there have been placed 2,600 linear feet of full concrete lining and 29,350 linear feet of side lining. In all 8,400 linear feet of full concrete lining and 32,000 linear feet of side lining have been laid, involving the placing of 65,390 square yards or 5,667 cubic yards of concrete.

COLD SPRINGS DAM.

Cold Springs Dam, located about 6 miles from Hermiston, is an earth and gravel embankment having an extreme length of over 3,800 feet and a maximum height of 98 feet. The maximum depth of water in the reservoir formed by the dam is 88 feet and the spillway crest is at an elevation 61½ feet above the bottom of the outlet conduit.

Plans for the dam were prepared during the winter of 1905–6, and proposals for construction were opened on June 28, 1906. All bids were rejected and the work was readvertised. The bids received under the readvertisement were also considered excessive and were rejected, and the construction of the dam by Government forces was authorized. Work was begun late in the fall of 1906 and the building of the embankment was commenced on May 11, 1907, and was completed in June, 1908.

The reservoir has been operated continuously without any repairs worthy of mention. A little tile drainage has been placed near the toe of the dam. This has effectively cared for all seepage and rendered the ground adjacent to the dam solid at all times of the year, although the reservoir has been substantially full each year but one since 1910.

DISTRIBUTION SYSTEM.

Water is distributed to the irrigable lands on the Umatilla project by means of three canal systems. The system, the construction of which was undertaken first by the Reclamation Service, consists of a main canal heading at Cold Springs reservoir and also connected to the feed canal by a by-pass, together with the necessary laterals and conduits. The second canal system diverts water from Umatilla River near the mouth of Butter Creek, reaches the irrigable land in a distance of 2½ miles, and in an additional distance of 8 miles completely merges with the reservoir canal system. The canal diverting from the Umatilla River was formerly owned by the Maxwell Land & Irrigation Co. and was acquired by the United States through purchase.

Proposals for the excavation of two schedules of the distribution system, involving the removal of about 245,000 cubic yards of material, were opened on October 1, 1906. A contract for the work under the first schedule, including the excavation of about 130,000 cubic yards of material, was executed in October, 1906. The bids for the second schedule were rejected, the work was subdivided into six sections and readvertised, the proposals being opened on November 30, 1906. The work on the six sections was undertaken under three contracts. The two schedules, involving about 34 miles of canals, were completed in June, 1908. Extension of the lateral system, involving the excavation of about 70,000 cubic yards of material, was contracted for in November, 1907. During the winter of 1908–9, 10 miles of canals and laterals for the distribution of water on the second unit were built by Government forces. This work involved the excavation of about 60,000 cubic yards of material. During the winter of 1909–10, 7 miles of canals and laterals, involving the excavation of about 30,000 cubic yards of material, were constructed by Government forces.

During the winter of 1910–11, 5 miles of lateral were built by Government forces to extend the distribution system over the fourth unit.

On account of the sandy soil and excessive seepage loss a considerable portion of the distribution system has been lined with concrete or mortar from 1½ inches to 2 inches thick. Some work has been done each year. In addition 4,000 linear feet of 30-inch, 15,800 linear feet of 20-inch, and 21,000 linear feet of 16-inch cement pipe have been laid acting under heads of 20 feet or less; also 3,800 linear feet of 20-inch and 4,100 linear feet of 16-inch wood pipe have been laid. Some of the wood pipe acts under heads as great as 90 feet. In all, nearly 22 miles of distributaries have been fully lined with concrete or mortar and about 5 miles lined on one side, requiring the placing of 158,000 square yards, or 7,140 cubic yards, of concrete.

MAXWELL DIVERSION DAM.

In the fall of 1913 the old diversion works of the Maxwell system were replaced by concrete headworks, and one quarter of a mile of the upper end of the canal was reconstructed. The total cost of the diversion works was $4,400. Four hundred and seventy cubic yards of material, largely indurated, were removed from the river bed, and 183 cubic yards of reinforced concrete were placed. In the fall of 1915 the diversion works were improved by the construction of a concrete weir 2 feet in height. The work involved the placing of 42 cubic yards of concrete.

WEST EXTENSION.

On June 10, 1913, the Secretary of the Interior gave tentative approval of the west extension by authorizing a 10,000-acre unit, contingent upon certain arrangements being executed with the Oregon Land & Water Co. The proposed court order pledging the above holdings was approved by the Secretary November 7, 1913.

Main canal.—On December 22, 1913, authority was received to begin grading on the main canal. Advertisements were issued promptly for the necessary equipment, and the work was begun early in January. By June 30, 1916, the main canal, concrete lined throughout, was completed. Its length is 26.6 miles, and its construction involved the excavation of 656,000 cubic yards of material and the placing of 36,200 cubic yards of concrete.

Three-mile Falls Diversion Dam.—The board which passed on the plans for the Three-mile Falls Diversion Dam submitted its report on January 27, 1914. Messrs. D. C. Henny, A. J. Wiley, E. G. Hopson, and H. D. Newell were members of the board. Plans and specifications were issued February 25, 1914. Proposals were opened May 28, 1914. The lowest bidder was Morrison-Knudsen Co., of Boise, Idaho, to whom the contract was awarded. Construction began early in July, and the dam was finished the early part of November. Its construction involved the excavation of 6,700 cubic yards of material, mostly rock, and the placing of 4,160 cubic yards of concrete. The dam is of multiple-arch type, consisting of 40 arches supported by piers placed 20 feet center to center. The maximum height of the dam above stream bed is 24 feet. The total cost of the dam is $73,600, including all rights of way.

DRAINAGE.

During the season of 1908 water was first turned into the distribution system. Excessive seepage losses were at once apparent, particularly around the large pothole close to Hermiston. By the end of the season a small pond had formed having a maximum area of perhaps 1 acre. During 1909 conditions became much worse. By the end of September fully 240 acres were submerged. As the necessity for comprehensive drainage was apparent, a recommendation was made on October 15 for an allotment of $15,000 for a main drain. During the fall of 1909 and spring of 1910 considerable work was done. From time to time additional funds were allotted. In January, 1912, a drag line excavator was transferred from the Klamath project. The Hermiston drain was deepened and enlarged. During 1911 a small drain was built in the northeastern portion of the project, and in the spring of 1912 an additional drain was also built in the same vicinity. In all, four main drains have been built, having an aggregate length of 10 miles; 295,000 cubic yards of material have been moved, the cost to date being $57,900. The drainage provided has in general been adequate to hold the level of ground water to safe limits. The remaining drainage should be performed by the individual water user or by small districts composed of a number of water users.

CONSTRUCTION DURING FISCAL YEAR.

Feed canal.—Two hundred and sixty-nine linear feet were lined with concrete on one side; the volume of concrete placed amounted to 65 cubic yards.

Distribution system.—Five thousand one hundred and forty-four linear feet of full lining and 2,746 linear feet of side lining were laid, involving the placing of 404 cubic yards of concrete. Six thousand and forty-nine linear feet of 16-inch and 8,615 linear feet of 20-inch pipe were laid, largely as supplemental construction for various small groups of water users. A concrete weir was built at the Maxwell Dam, involving the placing of 42 cubic yards of concrete.

West extension.—Eleven and six-tenths miles of main canal were built and lined with concrete 3 inches thick; 7.66 miles of laterals were built and lined with concrete 1½ and 2 inches thick. In addition 1,270 linear feet of 16-inch and 530 linear feet of 20-inch pipe were placed, part in a pipe drop, the rest in a pipe turnout. Work done on the west extension involved the placing of 16,193 cubic yards of concrete.

OPERATION AND MAINTENANCE.

Diversion of water to the feed canal for storage purposes was resumed November 20, 1915, and was continued until June 15. On the 27th diversion was again possible, due to heavy rains, and the canal was operated throughout the remainder of the month. Extreme cold and snow prevented delivery of water to the reservoir for 18 days in January and 13 days in February; 53,700 acre-feet were diverted for storage purposes, of which 49,650 acre-feet reached the reservoir. The reservoir was substantially full by April 8 and so maintained until the middle of June. Available storage on June 30 was 46,300 acre-feet. Delivery of water to the distribution system began on April 1; the total discharge from the reservoir to June 30 was 14,890 acre-feet. Delivery of water to the Maxwell Canal began on April 6; the total diversion to June 30 amounted to 11,000 acre-feet. The area of irrigable holdings on that portion of the project east of the Umatilla River is estimated to be 10,000 acres, and the area actually irrigated 5,500 acres.

West extension.—Practically no water was diverted into the main canal for irrigation. A small head has been run for construction purposes. Since June 1, 1916, 400 acres having vested water rights from the system of the Oregon Land & Water Co. have been served by the United States.

Historical review, Umatilla project.

Item.	1911	1912	1913	1914	1915	1916, estimated.
Acreage for which service was prepared to supply water	17,252	17,252	18,300	17,587	16,000	20,000
Acreage irrigated	3,500	4,600	5,000	5,100	5,300	6,000
Miles of canal operated	112	112	112	112	112	147
Water diverted (acre-feet)	78,960	90,000	81,500	59,900	86,200	70,000
Water delivered to land (acre-feet)	34,100	38,000	42,250	36,300	29,550	33,000
Per acre of land irrigated (acre-feet)	9.70	8.20	8.45	7.10	5.57	5.50

SETTLEMENT.

The total population of the project in 1915 was 1,600, about 600 living in the corporate limits of the city of Hermiston. Settlement has advanced slowly. On May 12, 1916, a public notice was issued announcing that homestead entries might be made and water-right applications would be receivable on June 14 for about 2,800 acres of land contiguous to the main canal of the west extension. Seven tracts of public land were filed upon, totaling 156.6 acres. There remain open for entry 29 tracts with a total irrigable area of 712.7 acres. The Northern Pacific Co. placed about 400 acres of land on the market at prices of $20 an acre and less. Several tracts were bought promptly, but no water-right applications therefor had been made at the close of the fiscal year.

Settlement data, Umatilla project.

Item.	1914	1915	1916, estimated.
Total number of farms on project[1]	440	542	540
Population	800	721	900
Number of irrigated farms	320	306	350
Operated by owners or managers	220	178	240
Operated by tenants	100	128	110
Population	740	721	900
Number of towns	1	2	3
Population	600	850	900
Population in towns and on farms	1,400	1,571	1,800
Number of public schools	2	4	5
Number of churches	4	4	6
Number of banks	1	1	1
Total capital stock	$25,000	$25,000	$25,000
Total amount of deposits	$100,000	$85,000	$85,000
Total number of depositors	600	600	600

[1] Number of water-right applications and rental contracts.

PRINCIPAL CROPS.

During 1915 approximately 5,300 acres were irrigated and 3,600 acres cropped, the difference being mainly young orchards. The value of crops was $104,600, as compared with $88,000 during 1914. The year was generally favorable for crop growth. Little damage was done by grasshoppers, there having been a marked improvement over the two preceding years. Rabbits caused considerable loss, especially on the outskirts of the project.

The agricultural situation for 1916 is promising except to those growing peaches and apricots. Extreme cold during January caused much damage to peach trees, besides generally killing the peach and apricot crop. Persistent winds have made spring seeding difficult. The cold winter resulted in exhausting the hay crop of 1915, so there are good prospects that growers will receive more than the average price for alfalfa.

Crop report Umatilla project, Oregon, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	2,396.8	Tons	9,141	3.8	$8.07	$73,768	$30.78
Apples	53.5	Pounds	16,400	306.7	.02	328	6.13
Barley	72	Bushels	1,900	26.4	.60	1,140	15.83
Clover hay	4.5	Tons	15.5	3.4	8.00	124	27.55
Corn, Indian	113.3	Bushels	3,778	33.3	.954	3,604	31.81
Corn, fodder	67.2	Tons	252	3.8	3.69	930	13.84
Clover seed	2	Bushels	7	3.5	12.50	87	43.75
Garden	37.9					3,585	94.59
Hay, other	169.5	Tons	209.7	1.2	6.66	1,396	8.24
Melons	27.4	...do	150	5.5	10.06	1,509	55.07
Onions	2	Bushels	470	235	.60	282	141.00
Peaches	130.6	Pounds	276,800	2,119.4	.007	1,937	14.83
Pears	8.5	...do	6,050	711.8	.03	181	21.35
Potatoes	55.4	Bushels	5,970	107.8	.61	3,642	65.57
Pasture	378.5					5,772	15.25
Small fruits	40.1	Pounds	42,830	1,068.1	.049	2,099	50.12
Sorghum	10.3	Bushels	432	41.9	.766	331	32.12
Wheat	9	...do	260	28.9	.80	208	23.11
Miscellaneous	99.5					3,729	37.49
Less duplicated areas	74.6						
Total cropped acreage	3,603.4	Total and average				104,653	29.04

		Areas.	Acres.	Farms.	Per cent of project.[1]
Irrigated, no crop:		Total irrigable area farms reported	9,698.1	306	57.0
Fall plowed	84	Total irrigated area farms reported[2]	5,306.4	306	31.2
Miscellaneous	264.5	Under water-right applications	4,115.6	238	24.2
New alfalfa	416.5	Under rental contracts	193.7	7	1.1
Nonbearing orchard	1,060	Under rental contracts (sandy area).	750.7	63	4.4
Less duplicated areas	122	Miscellaneous[3]	246.4	6	1.5
Total irrigated acreage	5,306.4	Total cropped area farms reported	3,603.4	306	15.3

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[1] Per cent based on 17,000 acres.

[2] Eight farms are partly under water-right application and partly under rental contract.

[3] Under Maxwell water right, 179 acres; under departmental regulations, 32.4 acres; vested water right, 35 acres.

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, DECEMBER 15, 1915.

1. Under the provisions of the reclamation act of June 17, 1902 (32 Stat. 388), and acts amendatory thereof or supplementary thereto, particularly section 4 of the reclamation extension act of August 13, 1914 (38 Stat. 686), it appears that a majority of the water-right applicants and entrymen in district No. 1 of the Umatilla project have made agreements providing for an increase in the cost of construction in the sum of $7.25 for the construction of cement-lined distributaries. The said agreements are hereby ratified and the said increase in the construction charge is hereby made effective in accordance with the conditions of the said contract as follows:

2. The lands in district No. 1 are described as follows:

Sec. 5, T. 4 N., R. 29 E., W. M.:	Acres irrigable.
SE. ¼ SW. ¼ NW. ¼	10
SE. ½ N. ½ SW. ¼ NW. ¼ and SW. ¼ SW. ¼ NW. ¼	18
NW. ¼ NW. ¼ SW. ¼	10
NE. ¼ NW. ¼ SW. ¼	10
Sec. 6, SE. ¼ SE. ¼ NE. ¼	10

3. The construction charge for all water-right applicants and entrymen in said district shall be increased $7.25 per irrigable acre.

4. The said increase of $7.25 per acre shall be added to the construction charge and distributed over the remaining unpaid installments of construction charges, payment of said $7.25 per irrigable acre to be made in the following manner:

Two per cent shall be added to the installment of such construction charge becoming due December 1, 1915, and to each installment becoming due each year thereafter up to and including the installment due December 1, 1917.

Four per cent shall be added to the installment becoming due December 1, 1918, and to the installment becoming due December 1, 1919.

Six per cent shall be added to the installment becoming due December 1, 1920, and to each installment becoming due each year thereafter up to and including the installment due December 1, 1932.

Eight per cent shall be added to the installment becoming due December 1, 1933.

Andrieus A. Jones,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, DECEMBER 15, 1915.

1. Under the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof or supplementary thereto, particularly section 4 of the reclamation extension act of August 13, 1914 (38 Stat., 686), it appears that a majority of the water-right applicants and entrymen in district No. 2 of the Umatilla project have made agreements providing for an increase in the cost of construction in the sum of $12.50 for the construction of a pipe line. The said agreements are hereby ratified and the said increase in the con-

struction charge is hereby made effective in accordance with the conditions of the said contract as follows:

2. The lands in district No. 2 are described as follows:

Sec. 6, T. 4 N., R. 29 E., W. M.:	Acres irrigable.
W. ½ SE. ¼ NW. ¼	20
E. ½ SE. ¼ NW. ¼	4.5
E. ½ NE. ¼ SW. ¼	19
W. ½ NE. ¼ SW. ¼	17

3. The construction charge for all water-right applicants and entrymen in said district shall be increased $12.50 per irrigable acre.

4. The said increase of $12.50 per acre shall be added to the construction charge and distributed over the remaining unpaid installments of construction charges, payment of said $12.50 per irrigable acre to be made in the following manner:

Two per cent shall be added to the installment of such construction charge becoming due December 1, 1915, and to each installment becoming due each year thereafter up to and including the installment due December 1, 1917;

Four per cent shall be added to the installment becoming due December 1, 1918, and to the installment becoming due December 1, 1919;

Six per cent shall be added to the installment becoming due December 1, 1920, and to each installment becoming due each year thereafter up to and including the installment due December 1, 1932;

Eight per cent shall be added to the installment becoming due December 1, 1933.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, APRIL 12, 1916.

1. Under the provisions of the reclamation act of June 17, 1902 (32 Stat., 388) and acts amendatory thereof or supplementary thereto, particularly section 4 of the reclamation extension act of August 13, 1914 (38 Stat., 686), it appears that a majority of the water-right applicants and entrymen in district No. 3 of the Umatilla project have made agreements providing for an increase in the cost of construction in the sum of $17.50 per irrigable acre, for the construction of a concrete-lined canal and cement pipe line. The said agreements are hereby ratified and the said increase in the construction charge is hereby made effective in accordance with the conditions of the said contract as follows:

2. The lands in district No. 3 are described as follows:

T. 4 N., R. 29 E., W. M.:	Acres irrigable.
SE. ¼ NE. ¼ NE. ¼, sec. 16	10
NE. ¼ SE. ¼ NE. ¼, sec. 16	10
N. ½ NW. ¼, sec. 15	80
N. ½ SW. ¼ NW. ¼, sec. 15	20
NW. ¼ SE. ¼ NW. ¼, sec. 15	10

3. The construction charge for all water-right applicants and entrymen in said district shall be increased $17.50 per irrigable acre.

4. The said increase of $17.50 per acre shall be added to the construction charge and payment thereof made in additional annual installments payable under the reclamation extension act, each of which

additional installments shall be at least equal to the amount of the largest installment as fixed for said land by public notice theretofore issued, but the final installment to cover the balance due shall in no event be less than such largest installment.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, APRIL 12, 1916.

1. Under the provisions of the reclamation act of June 17, 1902 (32 Stat., 388) and acts amendatory thereof or supplementary thereto, particularly section 4 of the reclamation extension act of August 13, 1914 (38 Stat., 686), it appears that a majority of the water-right applicants and entrymen in district No. 4 of the Umatilla project have made agreements providing for an increase in the cost of construction in the sum of $14.30 per irrigable acre for the construction of a concrete-lined canal and a 20-inch cement pipe line whereby water may be diverted from Canal D at the north boundary of the SW. ¼, sec. 3, T. 4 N., R. 28 E., W. M., and delivered at the southwest corner of the N. ½ NE. ¼ SE. ¼, sec. 4, T. 4 N., R. 28 E., W. M., distant approximately 2,400 feet from the point of diversion. From the point of delivery as above described, a concrete-lined canal will be built running in a northerly direction about 700 feet, which will deliver water near the southwest corner of SE. ¼ NE. ¼, sec. 4, T. 4 N., R. 28 E., W. M. From the said point of delivery a concrete-lined canal will be built, running in a southerly direction about 2,000 feet, which will deliver water near the southwest corner of the SE. ¼ SE. ¼, sec. 4, T. 4 N., R. 28 E., W. M. The total cost will be approximately $3,570, or not to exceed $14.30 per irrigable acre of land within the district described as follows, viz:

T. 4 N., R. 28 E., W. M.: Sec. 4; SE. ¼, that portion of the SE. ¼ NE. ¼ lying south of the Umatilla River and south of the Hermiston drain; E. ½ E. ½ NE. ¼ SW. ¼ and E. ½ E. ½ W. ½ NE. ¼ SW. ¼; sec. 9, N. ½ NE. ¼ NE. ¼, N. ½ NW. ¼ NE. ¼, and N. ½ S. ½ NW. ¼ NE. ¼.

2. Such increased charge of $14.30 per irrigable acre shall be added to the construction charge and payment thereof made in additional annual installments after the expiration of the 20 installments payable under the reclamation extension act, each of which additional installments shall be at least equal to the amount of the largest installment as fixed for said land by public notice heretofore issued, but the final installment to cover the balance due shall in no event be less than such largest installment. Payments for the increased charge shall be applicable to all of the lands hereinabove described.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, APRIL 12, 1916.

1. Under the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof or supplementary thereto, particularly section 4 of the reclamation extension act of August 13, 1914 (38 Stat., 686), it appears that a majority of the water-right applicants and entrymen in district No. 5 of the Umatilla project

have made agreements providing for an increase in the cost of construction in the sum of $17.50 for the construction of a 20-inch cement pipe line about one-third of a mile long, two 16-inch pipe lines each about 800 feet long, which will deliver water to the commanding point of three forties; also a small concrete-lined lateral one-eighth of a mile long. Necessary turnouts will be provided for delivery of water at commanding points of the five forties affected. The said agreements are hereby ratified and the said increase in the construction charge is hereby made effective in accordance with the conditions of the said contract as follows:

2. The lands in district No. 5 are described as follows:

T. 4 N., R. 28 E., W. M.: Sec. 15, SW. ¼ SW. ¼ and that portion of SE. ¼ SW ¼ south of Maxwell Canal and west of the right of way of the Oregon-Washington Railroad & Navigation Co.; sec. 16, S. ½ SE. ¼, S. ½ NW. ¼ SE. ¼ SE. ¼, E. ½ SW. ¼ SE. ¼, SW. ¼ SW. ¼ SE. ¼ and S. ½ NW. ¼ SW. ¼ SE. ¼; sec. 21, N. ½ NE. ¼.

3. The construction charge for all water-right applicants and entrymen in said district shall be increased $17.50 per irrigable acre.

4. The said increase of $17.50 per acre shall be added to the construction charge and payment thereof made in additional annual installments after the expiration of the 20 installments payable under the reclamation extension act, each of which additional installments shall be at least equal to the amount of the largest installment as fixed for said land by public notice theretofore issued, but the final installment to cover the balance due shall in no event be less than such largest installment. Payments for the increased charge shall be applicable to all of the lands hereinabove described.

Andrieus A. Jones,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, MAY 12, 1916.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplementary thereto, particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water will be furnished from the west extension of the Umatilla project, Oregon, in the irrigation season of 1916 and each irrigation season thereafter upon the filing of proper water-right application for the irrigable lands shown on the following farm-unit plats, viz, Willamette meridian, T. 4 N., R. 24 E.; T 4 N., R. 25 E.; T. 4 N., R. 26 E.; T. 5 N., R. 27 E., approved March 23, 1916, by the First Assistant Secretary of the Interior and on file in the office of the project manager, United States Reclamation Service, Hermiston, Oreg., and the local land offices at La Grande, Oreg., and The Dalles, Oreg.

2. Homestead entries of the farm units shown on said plats embracing public lands of the United States may be made on and after June 14, 1916, at 9 o'clock a. m., at said local land offices, if found regular and accompanied by the certificate of the project manager, showing that water-right application has been filed and proper water-right charges deposited.

3. Warning is hereby expressly given that no person will be permitted to gain or exercise any rights whatever under any settlement or occupation begun prior to 9 a. m., June 14, 1916, on any lands

shown on said plats, provided, however, that this shall not interfere with any valid existing rights obtained by settlement or entry while the land was subject thereto. All persons desiring to acquire any public lands shown on said plats shall execute homestead application subject to the provisions of the reclamation act in the manner required by law, which, with the required fees and commissions accompanied by certificate of the project manager as to the filing of water-right application and payment of water-right charges as hereinafter provided, shall be presented to the local land offices at La Grande, Oreg., or The Dalles, Oreg., in person, by mail or otherwise, within a period of five days prior to June 14, 1916; that is, beginning not earlier than June 9, 1916. All entries filed as herein provided and reaching the local land offices not later than 9 a. m., June 14, 1916, shall be held and treated as simultaneously filed. Applications presented after that hour will be received and noted in the order of filing. Any application not based on a prior settlement right will be subject to valid settlement claims asserted in the manner required by law.

4. The registers and receivers will carefully compare all applications simultaneously filed as aforesaid and will dispose of them as follows:

(*a*) Where there is no conflict the application shall be allowed, irrespective of whether settlement is alleged.

(*b*) In case of conflicting applications and only one of the applicants alleges prior settlement his application shall be allowed and the others rejected.

(*c*) If two or more conflicting applications are received, each containing allegations of prior settlement, a hearing shall be ordered to determine the priority of right, and it shall be restricted to those alleging such right.

5. Where there are applications conflicting in whole or in part in which no one of the several applicants claims prior settlement, the registers and receivers will write on cards the names of the several applicants, and each of these cards shall be placed in an envelope upon which there is no distinctive or identifying mark, and at 2 o'clock p. m. on the date of opening to entry, if practicable (if not, at the same hour one week later), after all the envelopes containing the names of the several applicants shall have been thoroughly mixed in the presence of such persons as may desire to be present, they shall be drawn and numbered in order. The cards as numbered and drawn will be securely fastened to the applications of the respective persons, and the applications shall be allowed in such order. Where any applicant fails to obtain land applied for by him he will be permitted to elect whether he will amend his application to embrace other lands not affected by pending applications and otherwise subject thereto when such amended application is presented, or withdraw his original application without prejudice, and in the event of such withdrawal the fees and commissions will be returned by the receiver, and the water-right charges deposited will be returned by the project manager. Applications conflicting in whole with those previously allowed will be rejected in the usual manner.

6. The project manager will receive water-right applications accompanied by the proper water-right payments, which for the first payment from homestead entrymen under paragraphs 3, 4, and 5

hereof will be accepted in the form of New York draft or money order payable to the special fiscal agent, United States Reclamation Service, Hermiston, Oreg., or in currency, and issue certificates to applicants for public lands at any time after the date of this notice. Each application must be for a specific farm unit. More than one person may make water-right application for the same farm unit. Filing of water-right application and issuance of certificate gives no preference right to make entry. Acceptance of application will be indorsed thereon by the project manager when notified by the local land office that entry has been allowed. All other applications, with payments made, will be returned to applicants upon surrender by them of the certificate of filing issued by the project manager.

7. The limit of area per entry representing the acreage which, in the opinion of the Secretary of the Interior, may be reasonably required for the support of a family upon such lands is fixed at the amounts shown upon the plats for the several farm units. The maximum limit of area for which water-right application may be made for lands in private ownership shall be 160 acres of irrigable land for each landowner. Water-right applications for lands in private ownership may be made on and after the date of this notice. All water-right applications whether for public or private lands must be made to the project manager, United States Reclamation Service, Hermiston, Oreg.

8. The water-right charges per acre of irrigable land for the land shown on said plats are of two kinds:

(*a*) A charge of $92 per acre of irrigable land for the building of the irrigation system, termed the construction charge, and payable as follows:

(1) For lands that were entered prior to August 13, 1914, subject to the reclamation act, the first installment of the construction charge shall be due December 1, 1916, and subsequent installments December 1 of each year thereafter. The first 4 of such installments shall each be 2 per cent, the next 2 installments shall each be 4 per cent, and the next 14 installments shall each be 6 per cent of the total construction charge.

(2) For the remaining lands, an initial payment of 5 per cent of the construction charge shall be made at the time of entry or filing of water-right application, and the remainder of the construction charge shall be paid in 15 annual installments, the first 5 of which shall each be 5 per cent and the remainder each 7 per cent of the total construction charge. The first of said 15 annual installments shall become due and payable December 1 of the fifth calendar year after the initial installment, and subsequent installments shall become due on December 1 of each calendar year thereafter.

(*b*) An annual charge for operation and maintenance payable on March 1 of each year for the preceding irrigation season. The operation and maintenance charge for the irrigation season of 1916 shall be $1.50 per acre of irrigable land, whether water is used thereon or not, which will entitle the water user to 4 acre-feet of water per irrigable acre. Additional water supply will be furnished at the rate of 15 cents per acre-foot.

9. In all cases where water-right application for lands in private ownership or for lands under entries not subject to the reclamation

act shall not be made within one year after the date of this notice, the construction charge for such land shall be increased 5 per cent each year until such application is made and initial installment is paid.

10. Any water-right applicant or entryman may if he so elects pay the whole or any part of the construction charges owing by him within any shorter period than that provided by the public notices and orders applicable to his land.

11. All water-right charges must be paid to the proper officer of the United States Reclamation Service at Hermiston, Oreg., in cash or by New York draft, money order, or check.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, MAY 27, 1916.

1. Under the terms of existing public notices and orders, the operation and maintenance charges for the Umatilla project, Oregon, become due on March 1 of each year for the preceding irrigation season.

2. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, notice is hereby given that until further notice there will be no change in the due date for the operation and maintenance charge for the said project.

3. Hereafter no operation and maintenance charge shall be collected at the time water-right application is filed, but the first payment on account of operation and maintenance shall become due on March 1 of the year following that in which entry was made.

4. For operation and maintenance charges due March 1, 1917, and thereafter, the discount for payment made on or before the due date and the penalities for failure to make payment before the first day of the third calendar month after the due date will be applied as provided in section 6 of the said reclamation extension act, whether acceptances thereof have been filed or not.

5. The operation and maintenance charges for the irrigation season of 1916 shall be due March 1, 1917, and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of $1.40, which will permit delivery of not more than 4 acre-feet per acre. Additional water may be obtained at the rate of 15 cents per acre-foot.

6. The provisions of this public notice shall apply to all lands subject to public notice heretofore issued for the said project.

7. Except as hereinabove provided, all the terms and provisions of existing public notices and orders for the Umatilla project shall remain unchanged.

8. The foregoing public notice does not apply to the west extension of the Umatilla project.

BO SWEENEY,
Assistant Secretary.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 729.]

Feature costs of Umatilla project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys		$115,125.94
Storage system:		
Cold Springs Dam	$439,874.00	
Feed canal	318,927.60	
Lands and rights of way, etc	39,404.90	798,206.50
Canal system:		
Canal system, east side	81,899.91	
Main canal, west extension	549,992.89	
Siphon-Coyote Cut-Off, west extension	768.12	
Wasteway, main canal, west extension	1,980.34	
Wasteway culvert, west extension	1,000.08	
Administrative general expense	3,877.81	639,519.15
Lateral system:		
East side	430,996.52	
East side, supplemental construction	14,118.95	
West extension	54,818.52	
Administrative general expense	7,336.90	507,270.89
Drainage system:		
Hermiston drain	43,015.23	
Second unit drain	3,174.60	
Hat Rock drain	1,604.65	
Umatilla drain	6,022.69	
Miscellaneous	4,071.31	57,888.48
Farm units		2,402.56
Permanent improvements and lands:		
Buildings	24,558.14	
Miscellaneous	716.26	25,274.40
Telephone system, telephone line, west extension		2,640.47
Plant accounts		7,816.07
Operation and maintenance charges transferred to and compounded with construction charges		19,447.78
Gross cost of construction of project to June 30, 1916		2,175,592.24
Less revenues earned during construction period:		
Rental of buildings	4,599.25	
Rental of grazing and farming lands	21,891.46	
Rentals of irrigation water	95.54	
Contractors' freight refunds	1,055.31	
Forfeitures by defaulting bidders and contractors	100.00	
Other revenues, unclassified	10,060.00	
Profit on mess-house operations	2,687.78	
Profit on mercantile store operations	7.75	
Loss on hospital operations	[1] 1,061.19	
Amounts set up as reserves or depreciation charged to cost and not expended		39,435.90
Net cost of construction of project to June 30, 1916		2,136,156.34

[1] Deduct.

Estimated cost of contemplated work, Umatilla project during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examination and surveys, investigations for additional storage		$1,500.00
Storage works, feed canal enlargement (contract work)		40,000.00
Canal system, main canals (enlargement of Maxwell Canal, contract work)		10,000.00
Lateral system:		
Laterals and sublaterals	$50,000.00	
Tunnels, flumes, bridges, and siphons	50,000.00	
		100,000.00
Drainage system, open drains		6,000.00
Farm units:		
Examinations and surveys	2,200.00	
Office work, maps, plats, etc	1,800.00	
		4,000.00
Permanent improvements and land, buildings		4,000.00
Telephone system, telephone line, west extension		1,500.00
Operation and maintenance during construction (water rental basis)		10,100.00
Operation and maintenance under public notice		41,900.00
Messes		10,000.00
Hospitals		6,000.00
Total		235,000.00

OREGON-CALIFORNIA, KLAMATH PROJECT.

J. G. CAMP, project manager, Klamath Falls, Oreg.

LOCATION.

Counties: Klamath, Oreg.; Siskiyou and Modoc, Cal.

Townships: 38 to 41 S., Rs. 8 to 14 E., Willamette meridian; 46 to 48 N., Rs. 1 to 8 E., Mount Diablo meridian.

Railroad: California Northeastern.

Railroad stations and estimated population, January 1, 1916: Klamath Falls, 5,000; Midland, 100; and Ady, Oreg.

WATER SUPPLY.

Source of water supply: Upper Klamath Lake, Lost River, and Clear Lake.

Area of drainage basin: 3,700 square miles.

Annual run-off in acre-feet, 1904 to 1913: Link River at Klamath Falls (3,110 square miles)—Maximum, 2,530,000; minimum, 1,450,000; mean, 1,770,000. Lost River and Willow Creek at Clear Lake—Maximum 255,000; minimum, 35,000; mean, 125,000. Lost River at Olene and Merrill—Maximum, 475,000; minimum, 15,000; mean, 265,000.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916: 47,600 acres.

Area under water-right applications, season of 1916, 27,254 acres.

Length or irrigation season: From May 1 to September 30—153 days.

Average elevation of irrigable area: 4,100 feet above sea level.

Average annual rainfall on irrigable area: 9 years, 14.2 inches.

Range of temperature on irrigable lands: Minus 10° to 100° F.

Character of soil of irrigable area: Disintegrated basalt, volcanic ash, and diatomaceous earth, being largely classified as Yakima sandy loam.

Principal products: Alfalfa, hay, grain, and vegetables; stock, poultry, and dairy products.

Principal markets: Portland, Oreg.; Sacramento and San Francisco, Cal.

LANDS OPENED FOR IRRIGATION.

Dates of public notices and orders: November 18 and December 7, 1908; August 24, 1909; June 9, 1910; March 23 and September 24, 1914; March 26 and September 15, 1915; March 9 and 16, 1916.

Location of lands opened: T. 38 S., R. 9 E.; 39 S., Rs. 8 to 10 E.; 40 S., Rs. 9 to 11 E.; 41 S., Rs. 10 to 12 E., Willamette meridian, and 48 N., R. 5 E., Mount Diablo meridian.

Present status of irrigable lands opened: 44 acres entered subject to the reclamation act; 23 acres open to entry; 29,600 acres in private ownership.

Limit of area of farm units: 160 acres.

Duty of water, 1.8 acre-feet per acre per annum at the farm.

Building charge per acre of irrigable land, $30.

Annual operation and maintenance charge, season of 1916: Minimum charge, $1 per acre for 2 acre-feet; 20 cents for first additional acre-foot and 40 cents per acre-foot thereafter.

CHRONOLOGICAL SUMMARY.

Reconnoissance made in October and November, 1903.

Preliminary surveys begun in 1904.

Construction recommended by a board of engineers May 1, 1905.

Construction authorized by Secretary May 15, 1905.

Main canal completed August, 1907.
First irrigation by Reclamation Service season of 1907.
Keno Canal completed October, 1908.
South Branch Canal completed March, 1909.
Clear Lake Dam completed January, 1910.
Lost River Diversion Dam completed June, 1912.
Adams Canal enlargement begun October, 1913, completed April, 1914.
Second Unit lateral system begun October, 1912, completed June, 1915.
G Canal (enlargement of Griffith lateral), begun March 8, 1915, completed April 30, 1915.
Lateral, margin of Tule Lake, begun June 5, 1916; excavation practically completed June 30, 1916.
Entire project 59 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Klamath project provides for storage of water in the natural reservoir of Upper Klamath Lake, lying just north of Klamath Falls, Oreg., and in the Clear Lake Reservoir, Cal., at the head of Lost River and 6 miles east of Tule Lake. Water for irrigation is diverted from the east side of Link River, the outlet of Upper Klamath Lake, 700 feet from the lake, into the Main (A) Canal, which extends 9 miles in a southeasterly direction, supplying canals and laterals in the first unit of the project, and a portion of the second unit in Poe Valley and on Nuss Lateral. The water diverted from Lost River into the Griffith (G) Canal at the Lost River Dam, 10 miles southeast from Klamath Falls, Oreg., supplies the lands under that canal in the second unit and also the Adams Canal which covers the portion of the first unit east of Lost River, the lands on the margin of Tule Lake in private ownership, and a portion of the bed of Tule Lake in public ownership.

Clear Lake Dam and dikes were built mainly to withhold the waters of Lost River from Tule Lake into which that river empties. The water stored in the Clear Lake Reservoir will be released into Lost River whenever needed for irrigation. Tule Lake has no visible outlet, and it is proposed to reclaim about 30,000 acres of the lake bed by evaporation. To assist in this, the Lost River Diversion Dam and channel (8 miles long) were built to divert the flood waters of Lost River into Klamath River.

The present irrigation system consists of 210 miles of canals and laterals and 53 miles of open drains. These works cover 29,700 acres of irrigable land in the first unit, about 8,000 acres in the second unit, 3,460 acres of marginal lands of Tule Lake in private ownership, and 4,500 acres of Tule Lake bed in public ownership, a total irrigable area of 47,660 acres.

As the reclamation of the bed of Tule Lake progresses, a second diversion dam will be built in Lost River about 15 miles nearly south from the first dam. This will divert water east and west on the reclaimed area of the lake bed.

A canal known as the Keno Power Canal was built on the west bank of Link River, in Klamath Falls, Oreg., diverting water from the river 1,200 feet from its outlet from Upper Klamath Lake. This canal, primarily designed for power purposes, was also planned to furnish water for irrigating lands on the west side of Klamath River, southwest from Klamath Falls, Oreg. No power plant, however, has been installed by the Government, as all irrigation at present is by gravity flow.

An undeveloped power site is located at the drop from the Main (A) Canal into the South Branch (C) Canal, 9 miles southeast from Klamath Falls, Oreg.

The principal features of the project are the Clear Lake Reservoir, the Lost River diversion works, the Keno Power Canal, the Main Canal Tunnel, 3,300 feet long, and the main canals of the distributing system.

SUMMARY OF GENERAL DATA FOR KLAMATH PROJECT (OREGON-CALIFORNA) TO JUNE 30, 1916.

Areas:		
Irrigable acreage when project is complete		142,796
Public land entered, June 30, 1916	62	
Public land open to entry, June 30, 1916	30,123	
Private land, June 30, 1916	112,611	
Acreage service could have supplied season of 1915		36,000
Addition in fiscal year, 1916		6,840

Areas—Continued.			
Estimated addition in fiscal year, 1917			2,400
Estimated acreage service can supply July 1, 1917			45,240
Acreage actually irrigated, season of 1915			27,254
Acreage cropped under irrigation, season of 1915			27,254
Crops:			
Value of irrigated crops, season of 1915			$377,488.00
Value of irrigated crops per acre cropped			$13.85
Finances:			
Estimated cost of completed project			$4,564,000.00
Total construction cost to June 30, 1916			$2,692,791.56
Per cent complete, June 30, 1916			59
Appropriation for fiscal year 1917, total			$180,000.00
Allotment for construction, fiscal year 1917			$132,000.00
Estimated per cent complete, June 30, 1917			62
Announced construction charges per acre			$30.00
Appropriation, fiscal year 1916			$317,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation:			
Disbursements	$113,426.69		
Transfers	$9,991.93		
		$123,418.62	
Registered liabilities chargeable to 1916 appropriation		$20,296.82	
			$143,715.44
Unencumbered balance, July 1, 1916			$173,284.56
Repayments:			
Construction charges—			
Accrued to June 30, 1916			$294,571.27
Collected to June 30, 1916			$290,210.58
Uncollected, June 30, 1916			$4,360.69
Operation and maintenance charges (public notice)—			
Accrued to June 30, 1916			$149,726.87
Collected to June 30, 1916			$144,068.99
Uncollected, June 30, 1916			$5,657.88
Water rental charges—			
Accrued to June 30, 1916			$34,865.71
Collected to June 30, 1916			$34,723.21
Uncollected, June 30, 1916			$142.50
Drainage:			
Estimated acreage damaged by seepage to June 30, 1916			5,600
Miles of drains built to June 30, 1916, open			49
Estimated acreage protected by drains built to June 30, 1916			17,000
Estimated acreage to be protected by authorized system			29,600
Expended to June 30, 1916, on drainage works, completed and uncompleted			$182,385.06

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

MAIN CANAL.

The Main Canal heads on the east bank of Link River near the lower end of upper Klamath Lake and extends in a southeast direction about 9 miles to the junction of the east branch and south branch canals.

The principal structures on the Main Canal consist of the main headworks, two reinforced concrete culverts for carrying drainage water under the canal, two paved channels for the diversion of drainage into the canal, five Howe truss combination highway bridges, and the necessary turn-outs for the diversion of water to the distribution system. Plans for the Main Canal were prepared in 1905, and proposals were opened December 29, 1905. Two contracts were awarded—one for canal construction and one for highway bridges.

The contract for the Main Canal included all excavation, the driving and lining of the tunnel, and the placing of all concrete structures. Work on this contract was begun in March, 1906, and completed in July, 1907. The work under the contract for bridges was carried on during 1906 and the early part of 1907, the bridges being completed in the spring of 1907.

EAST BRANCH CANAL.

Proposals for the construction of the east branch canal from the end of the Main Canal to a few miles from Merrill, Oreg., were invited to be opened on June 21, 1906. No proposals were received, however, and in September, 1906, authority having been obtained, the work was begun by Government forces. During the latter part of 1906 and the first part of 1907 work on this canal was carried on by Government forces and excavations completed from the end of the Main Canal to Olene, a distanee of about 4½ miles.

KENO CANAL.

The Keno Canal heads on the west side of Link River a short distance below the intake for the Main Canal.

Proposals for the construction of this canal were invited to be opened on April 15, 1907. But one proposal was received, which was considered excessive and was rejected and authority was obtained for doing the work by Government forces. Construction of the canal was begun in June, 1907, and completed in October, 1908.

SOUTH BRANCH CANAL.

The South Branch Canal extends from the end of the main canal southerly for a distance of about 13.2 miles to a point near Merrill, where it connects with the old Adams Canal at the flume crossing Lost River.

Proposals for construction of the South Branch Canal were opened April 1, 1908. The earthwork and wooden flume were constructed under three separate contracts, the work being done during 1908 and the first part of 1909. The foundations for the flume and the wooden lining of the earthen portion of the canal over the high fill were constructed by Government forces.

South Branch headgate.—This structure was built in 1908 of fir lumber. This was so badly rotted by the winter of 1914 that it had become unsafe. It was rebuilt of concrete in 1915, by Government forces, at a cost of $2,300.

DISTRIBUTION SYSTEM.

The distribution system under the Main, East Branch, and South Branch Canals, known as the first unit of the project, was constructed by Government forces and under informal contracts. The greater part of the work under the Main and East Branch Canals was constructed during 1906 and was used for irrigation during 1907. The distribution system under the South Branch Canal was constructed during the season of 1908 and the first part of 1909.

CLEAR LAKE DAM AND DIKES.

Clear Lake Dam is constructed across Lost River a short distance below where the stream leaves the marshes which border Clear Lake. The Clear Lake Dikes are constructed across a low saddle at the southwest extremity of the lake.

Proposals for the construction of the Cleak Lake Dam and Dikes were invited to be opened April 15, 1908. Two proposals were received for the work, both of which were considered excessive and were rejected. On August 15, 1908, authority for the doing of this work by Government forces was granted. Work was begun on the excavation of the channel for the outlet conduit for Clear Lake Dam in the fall of 1908 and carried on as late as weather conditions would permit. Work was resumed in May, 1909, and the dam was practically completed before operations were suspended for the following winter. Final completion of the work was accomplished in the spring of 1910. Work was commenced on the Clear Lake Dikes on October 6, 1909, and completed December 20 of that year.

ADAMS CANAL ENLARGEMENT.

This canal was built by J. Frank Adams and his neighboring farmers in 1886 to 1889 and extended from Lower Klamath Lake to Stukel Mountain and along the southern foot of that mountain to the middle of the eastern shore of Tule Lake, a length of over 30 miles, including the southern portion known as the Carr Canal. These canals were bought by the Government in 1905 and became a part of the first unit of the Klamath project. A recommendation was made that these canals be enlarged, giving them a uniform subgrade and a section that tapered from a capacity of 195 second-feet to 36 second-feet at the lower or eastern end. The canal had been roughly built, the banks here high, there low, the sections irregular, and the subgrade very uneven. These high spots and narrow sections greatly reduced the capacity. The recommendation to enlarge was approved February 5, 1913, and work began October 1, 1913. A number of small contracts were let covering 69 per cent of the excavation and the remainder and the structures were built by Government forces. The enlarged canal is intended to supply 10,700 acres in the first unit, 3,460 acres of lands on the margin of Tule Lake in private ownership, and 5,300 acres of public land in the bed of Tule Lake. The work was suspended because of bad weather from December 15, 1913, to in February, 1914, and completed April 30, 1914. The excavation by contract was 103,924 cubic yards of earth; contractors' prices, average, $0.193, United States cost $0.052, total cost $0.245. The work done by Government forces was 10,179 cubic yards, mainly loose and solid rock, at a cost of $1.23 per cubic yard. The structures built by Government forces were 22 wooden bridges, 32 feet span, 12 concrete checks, and 4 concrete turnouts.

LOST RIVER DIVERSION WORKS.

The successful reclamation of the north end of the bed of Tule Lake depends on preventing the larger part of the spring floods of Lost River from entering the lake. The Clear Lake Reservoir, completed in 1910, retains the flood water of the Upper Lost River, the evaporation and inflow seepage and inflow being equal. The run-off below the reservoir in Lost River varies from 25,000 to 120,000 acre-feet annually. It was planned to handle this by building a dam at the north end of Stukel Mountain (Mount Laki) and a diversion channel 8 miles long thence to Klamath River directly west, thus diverting excess water before it could reach Tule Lake. The dam was located at Wilson Bridge, 10 miles southeast from Klamath Falls, Oreg., and the plans were approved July 26, 1910; bids were opened for the dam December 29, 1910, and the contract was awarded to George C. Clark.

The dam is a U-shaped, multi-arch, concrete structure, with an interior pool 110 feet long by 60 feet wide. It is 34 feet above the bed of the river, and earth embankments connect it with higher ground on each side. It contains 5,600 cubic yards of concrete and 13,140 cubic yards of earth embankment. The headgates for the diversion channel are on the north side of the dam and those for the G Canal on the south side. Water was stored above the dam in April, 1912, and diverted in May, 1912, but the dam was not completed until October, 1912.

The diversion channel, 8 miles long, extends west through the Lost River and Klamath Valleys to Klamath River. The excavation covered 467,400 cubic yards of material. Bids were opened December 15, 1910, and the contracts awarded to W. H. Mason and James W. Jory for the excavation. The work was not pushed as it should have been and was not completed until May 1, 1912. The channel has a capacity of 420 second-feet, and since its completion has diverted the flood waters of Lost River, excepting the peaks of the floods, thus assisting greatly in the reclamation of the bed of Tule Lake.

SUBLATERALS IN THE FIRST UNIT.

When the sublateral system of the first unit was built there were a number of cases where delivery was made to private laterals instead of to the farm units. These were found to be insufficient and caused many disputes between the farmers. For these reasons it was decided to take over and rebuild such of these as the owners were willing to turn over to the Government. Agreements were entered into in June, 1915, with the water users of the first unit, which provided for an additional construction charge of $12.50 per acre to cover the cost of reconstruction of these laterals, the additional drainage required on the unit, and rebuilding in concrete the larger structures of wood as these became decayed. The owners of these sublaterals have been reluctant to turn them over to the Government, so that little has been done, only preliminary surveys being made in 1915.

CONSTRUCTION OF THE SECOND UNIT.

A board of engineers was convened August 8, 1911, to consider the construction of the second unit of the Klamath project. The members were A. P. Davis, chief engineer, E. G. Hopson, supervising engineer, and W. W. Patch, project engineer. After inspection of the proposed unit, they recommended its immediate construction. On August 19, 1911, the director authorized the work, but difficulties in securing the rights of way prevented construction during 1911.

Proposals were advertised July 3, 1912, and opened August 20, 1912. Contract was awarded to Maney Bros., Boise, Idaho, on September 16, 1912; the contractors began work October 21, 1912, and finished the work in August, 1913. The North Poe, the South Poe, and Nuss laterals with their sublaterals are supplied from the East Branch (B) Canal, which terminates at Olene Gap, 10 miles nearly east from Klamath Falls, Oreg. The North Poe and the South Poe are located on the north and south sides of Poe Valley, and Nuss Lake lateral extends west from Olene Gap and south of Lost River to the Lost River Diversion Dam. Water is supplied directly to the North Poe lateral from B Canal, and a metal flume conveys the water across the river at Olene Gap to supply the other two. This flume, placed on a wooden trestle with concrete foundations, is 304 feet long. The Griffith (G) Canal diverts from Lost River on the south side of Lost River Dam and runs southerly along the base of Mount Stukel, supplying water for irrigation of a narrow strip east of Lost River.

The irrigable areas in the second unit are: Under North Poe, 1,549 acres; South Poe, 3,766; Nuss Lake, 1,181; Griffith, 1,318; and Griffith extension, 563; a total of 8,377 acres.

GRIFFITH (G) CANAL, ENLARGEMENT OF GRIFFITH LATERAL.

The Griffith lateral was built in 1912 and 1913 as a part of the distribution system of the second unit, to irrigate 1,318 acres of land east and north of Lost River, at the foot of Stukel Mountain. It had a capacity of 25 second-feet at the head and 10 second-feet at the southern end. In May, 1913, it was extended 5 miles to supply 563 acres of irrigable land not previously included.

In December, 1914, a board of engineers, consisting of D. C. Henny, E. G. Hopson, and J. G. Camp, approved a plan to enlarge this lateral into a main canal with 190 second-feet capacity, to supply water to Adams Canal in addition to irrigation of adjacent lands, thus utilizing the summer flow of Lost River and withdrawing that water from the diversion channel. Agreements were signed by the water users in the first unit providing that should the excavation involving 182,000 cubic yards cost more than the original estimate for the project of $30 per acre, the excess should be added thereto as supplemental construction.

The enlargement of the lateral into a carrying canal was authorized by the director and chief engineer on March 3, 1915, approving the plan of doing the work partly by contract and the balance by Government forces. Work was begun promptly with large forces, 35 per cent of the excavation being contracted and 65 per cent being done by Government forces. The total excavation equaled 187,993 cubic yards, of which 133,803 cubic yards were earth, 53,656 cubic yards loose rock, and 534 cubic yards hard rock. It was completed on April 28, 1915, and the water for irrigation was turned in on May 1, 1915.

MEASURING DEVICES.

When the irrigation system of the first and second units was built only a few measuring devices were placed in the principal canals and laterals. Deliveries were made to farm units through wooden turnout boxes, without attempt to measure the quantities. When the reclamation extension act was passed, this made it obligatory to measure the deliveries of water, involving building measuring devices over the whole of the lands then under irrigation. Preliminary work was begun in 1914 and construction of the structures begun in March, 1915, by Government forces. Many of the wooden structures were badly rotted, and in the case of the larger structures were replaced by concrete.

CONSTRUCTION DURING FISCAL YEAR.

Drainage.—An Austin trenching machine was added to the drainage equipment, arriving on the project on June 17, 1916. This will be used for digging trenches for tile drains as well as for excavating some of the smaller open drains.

Laterals on marginal lands, Tule Lake.—This marginal land consists of two tracts on the north shore of Tule Lake, uncovered in the process of reclaiming the bed of the lake. First is the land in private ownership, 3,460 acres, a tract about one-half mile wide and 12 miles long, adjacent to and south of the lands in the first unit. They were not included in the public notice for the first unit in November, 1908, because they were partially under the water of the lake at that time. The water surface of the lake has been lowered 8.5 feet in its reclamation, and these lands and 5,300 acres of public lands, south of and adjacent to them, have been uncovered. This second tract is also a long and narrow strip, averaging three-fourths mile wide. The first unit canal system was designed large enough to cover these lands through the Adams Canal, but no lateral system had been built for them.

The construction of such laterals was authorized in May, 1916, and they were constructed in June, 1916, leading south from the Adams Canal. They were generally of 10 second-feet capacity, built on a flat slope, in economic cut. The excavation was all class 1 earth and there were no engineering difficulties. There were 24 schedules with a total excavation of 59,418 cubic yards, of which 14,597 cubic yards were excavated by contractors and the remainder by Government forces. The excavation was practically completed on June 30, 1916. The structures were begun in June by Government forces and will be finished in July, 1916. The total length is 23.8 miles, and the excavation was completed in 25 days.

SEEPAGE AND DRAINAGE.

The drainage and seepage problems were not considered serious prior to 1913, although it was known that excess irrigation water would gather in certain low areas without natural surface outlets. Shallow drains 2 to 3 feet in depth were built to carry this away, but in 1912 some seeped areas appeared, becoming quite serious in

1913, especially in lands adjacent to the Lost River diversion channel and below the Main (A) Canal.

In May, 1914, a board of engineers, consisting of W. H. Sanders, D. C. Henny, and E. G. Hopson, met at Klamath Falls, Oreg., to consider remedies for this condition. Certain investigations to be made under the direction of D. W. Murphy, engineer in charge of drainage, were outlined by this board. These investigations showed that a large part of the seepage was from the canals of the project, due to the formation of the Klamath Valley. This consists of a top stratum of soil from 1 to 6 feet deep, overlying, generally, a grayish hardpan 6 inches to several feet thick. This slopes toward the lower portions of the valley more gradually than the surface of the top soil. For this reason the soil stratum is from 5 to 6 feet deep near the canals and not over 6 inches deep in the lower places, in some locations. The hardpan contains a large amount of white alkali and a less amount of black alkali, the distribution of the latter being local and not general. Under the hardpan, in most places, is a stratum of quicksand varying in thickness from a few inches to several feet. This rests in turn on a bedrock, which varies from a loose, shattered formation full of water to a bluish, hard, almost dry rock. This bedrock is from 100 to 500 feet thick.

The excavation for the canals cut through the hardpan in a number of places into the quicksand and in other places the hardpan was not penetrated. The seepage from the canals passes on top of the hardpan in the latter cases and under that stratum through the quicksand in the former and in both cases flows toward the lower portions of the valley. This seepage under the hardpan is strongly impregnated with alkali, and as it is under pressure, it breaks through wherever there are weak spots in the overlying stratum, joining the flow on top of that stratum. When this flow reaches shallow soil, it is brought to the surface by capillary attraction, the land is seeped, and evaporation leaves the alkali on the surface.

Two plans were adopted as remedies, one to cut deep toe drains just below the banks of the canals, the other to cut them at the upper edges of the seeped areas. In both cases the cut is to the quicksand, and where this is done the land is dried and the seepage conquered.

One main drain was built in the northern part of the Klamath Valley, extending from Lost River, one mile below the diversion dam, in a westerly direction eight miles to near the Klamath River. This empties into Lost River where it is 8 feet deep, and has a good slope from that point to its head, being deep enough at all points to take the flow of the smaller drains of this section, all of which empty into it. Four smaller drains empty into Lost River in the southern part of the project.

OPERATION AND MAINTENANCE.

The first unit has been operated during the year under public notice and the second unit and the Tule Lake marginal lands under water rental agreements, at $1 per acre-foot for the water used.

Water diversion from Link River in 1915 was 49,430 acre-feet and from Lost River 19,400 feet, a total of 68,830 acre-feet. Of this it is estimated that 56 per cent was lost and 44 per cent delivered to farm units for irrigation. No storage water was used during the year from Clear Lake Reservoir.

The minimum allowance on the first unit was 2 acre-feet per acre; very few exceeded the minimum and those by small amounts, the excess being used on very sandy lands.

The wooden structures built in 1907 and 1908 have rotted out to a large extent. Their replacement, begun in 1915, was continued in the fiscal year 1916, the larger structures being rebuilt of concrete. The greater number of these structures have now been rebuilt, but the large wooden flume in the South Branch Canal may need reconstruction in the fiscal year 1918 or 1919.

Historical review, Klamath project.

Item.	1911	1912	1913	1914	1915	1916
Acreage for which service was prepared to supply water	30,106	30,093	29,700	35,400	36,000	47,600
Acreage irrigated	23,869	23,834	18,928	24,440	[1] 27,254	....
Number of farms irrigated	384	405	325	333	315	....
Miles of canals operated	132	132	132	178	187	224
Water diverted (acre-feet)	45,600	42,100	38,000	56,750	68,830	....
Water delivered to land (acre-feet)	29,449	23,619	22,160	25,610	30,640	....
Per acre of land irrigated (acre-feet)	1.23	1.13	1.17	1.05	1.125	....

[1] The 27,254 acres irrigated include all lands under water-right application, much of which was not irrigated.

SETTLEMENT.

No changes of note have occurred during the year.

The Klamath Water Users' Association continues to work in harmony with the reclamation officials on the project. Charles A. Bunting, a farmer living near Merrill, Oreg., was elected president of the association to succeed Abel Ady, deceased, and was reelected at the last annual meeting of the association.

Settlement data, Klamath project.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	430	350	373	391	409
Population	1,100	1,125	1,375	1,520	1,580
Number of irrigated farms	405	325	333	352	409
Operated by owners or managers	365	259	250	247	287
Operated by tenants	40	66	83	105	122
Population	1,028	1,050	1,300	1,425	1,485
Number of towns	4	4	4	4	4
Population	5,290	5,300	4,500	4,700	5,000
Total population in towns and on farms	6,395	6,425	5,875	6,220	6,580
Number of public schools	16	16	18	19	20
Number of churches	9	9	9	9	9
Number of banks	4	3	3	3	3
Total capital stock	$275,000	$175,000	$175,000	$175,000	$175,000
Total amount of deposits	(1)	(1)	$1,000,000	$1,118,500	$1,219,846
Total number of depositors	(1)	(1)	2,600	3,565	4,281

[1] Figures not at hand; substantially as in 1914.

PRINCIPAL CROPS.

Alfalfa, timothy, alsike, red and white clovers, redtop, and orchard grass are the principal hay crops. Some sweet clover is grown on lands not well suited to the other grasses and experimental plots of Sudan grass have yielded well. Alfalfa does well on all lands where there is sufficient depth of soil. Alsike clover and redtop grow better on the shallower soils and on those partially seeped. Considerable areas were sown in grains in 1915 and in 1916 owing to high prices prevailing; the yield for 1915 was generally good for wheat, oats, barley, and rye. The season of 1916 was late with heavy frosts late in June, which will lower the yield for this season. Rutabagas, sugar beets, and potatoes yield well, though late frosts sometimes injure the potatoes. Fruits and berries do well and each farm can raise sufficient for home use without trouble. In some favored localities apples do well, and peaches, plums, prunes, and cherries are grown to a small extent. Pears do well and yield heavily. Owing to the elevation and consequent late frosts it can not be considered a fruit country.

Dry farming under normal rainfall is fairly successful, but in dry seasons is a failure. For this reason the farmers can afford to pay from $50 to $60 per acre for the construction of irrigation systems.

Crop report, Klamath project (Oreg.-Cal.), year of 1915.

Crop,	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	8,435	Tons	19,475	2.3	$8.00	$155,800	$18.50
Barley	4,639	Bushels	125,097	27.0	.60	75,058	16.20
Fruit	11					740	70.20
Garden	114					4,917	43.00
Hay, mixed, etc	1,209	Tons	1,628	1.35	8.00	13,024	10.80
Oats	3,634	Bushels	108,615	29.9	.40	43,446	11.50
Pasture	6,159					18,476	3.00
Potatoes	300	Bushels	21,420	71.4	.70	14,994	50.00
Rye	114	...do	1,992	17.5	.85	1,695	14.80
Wheat	2,617	...do	48,245	18.4	1.00	8,243	18.40
Sugar beets	22	Tons	219	9.7	5.00	1,095	48.70
Total acreage cropped and irrigated	27,254	Total and average				377,488.00	13.85

Areas.	Acres.	Farms.	Per cent of project.
Total irrigable area farms reported	33,247		
Total irrigated area farms reported	27,254	315	100
Under water-right applications		269	85
Under rental contracts		42	13
Vested rights	1,760	4	2
Total cropped area farms reported	27.254	315	100

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, SEPTEMBER 15, 1915.

1. Under the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof or supplementary thereto, particularly section 4 of the reclamation extension act of August 13, 1914 (38 Stat., 686), it appears that a majority of the water-right applicants and entrymen in the first unit of the Klamath project have made agreements providing for an increase in the cost of construction in the sum of $12.50 for the construction of drainage works. The said agreements are hereby ratified and the said increase in the con-

struction charge is hereby made effective in accordance with the conditions of the said contract as follows:

2. The construction charge of all water-right applicants and entrymen in the first unit of the Klamath project who have accepted the terms of the reclamation extension act shall be increased $12.50 per irrigable acre.

3. The said increase of $12.50 per acre shall be paid in additional annual installments after the expiration of the 20 installments payable under the reclamation extension act, being in the case of each individual equal to the largest of the annual installments theretofore paid under his water-right application; but the final installment may be less than that amount if equal to the balance of the charge then due.

4. The said increased charge and conditions of payment shall apply to all land within the first unit of the Klamath project now or hereafter becoming subject to the terms of the reclamation extension act whether described in water-right applications heretofore or hereafter made.

5. All lands within the first unit for which acceptances of the reclamation extension act have not been duly filed shall be charged with their proportion of the cost of these works, namely, $12.50 per irrigable acre, and payments shall be made by the addition to the annual operation and maintenance charge of $1.25 per irrigable acre for 10 years, beginning with the charge due March 1, 1917.

FRANKLIN K. LANE,
Secretary of the Interior.

PUBLIC NOTICE, MARCH 9, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, notice is hereby given that hereafter until further notice for all lands under the Klamath project, Oregon-California, the operation and maintenance charge for any irrigation season shall be due and payable on March 1 of the following calendar year.

2. The operation and maintenance charges for the irrigation season of 1916 and for each irrigation season thereafter until further notice shall be due on March 1 of the following year, and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of $1, which will permit delivery of not more than 2 acre-feet per acre. For the first acre-foot per acre additional the charge shall be at the rate of 20 cents per acre-foot, and should further quantities be needed they will be furnished at the rate of 40 cents per acre-foot.

3. The provisions of this public notice cover all lands subject to public notice heretofore issued for the said project.

4. Except as hereinabove provided, all the terms and provisions of existing public notices and orders and in particular the public notice of March 26, 1915, for the Klamath project shall remain unchanged.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[**Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 731.**]

Feature costs of Klamath project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys:		
Examination of project	$47,356.44	
Modoc unit	5,624.34	
Experimental farm	16,236.55	
Horsefly district	161.10	
Gaging streams	25,791.27	
Tule Lake outlets	20,622.32	
Sand Hollow	676.40	
Sand Hollow (cooperative)	1,103.18	
Pine Grove	174.85	
Upper Klamath Lake	4,450.99	
Administrative general expense	638.62	
		$122,836.06
Storage system:		
Clear Lake Dam and dikes	332,354.88	
Horsefly Reservoir site	670.49	
		333,025.37
Canal system:		
Main Canal	696,968.88	
East Branch Canal	49,639.53	
South Branch Canal	193,495.09	
Adams and Carr Canal	182,257.33	
Lost River diversion channel	309,399.47	
Griffith Canal (enlargement)	82,440.25	
Ankeny Canal	57,090.00	
Langell Valley canals	9,834.23	
Supplemental construction	72,457.98	
		1,653,582.76
Lateral system:		
First unit	150,820.54	
Second unit	113,676.73	
Tule Lake	17,106.49	
Administrative general expense	759.49	
		282,363.25
Drainage:		
First unit	112,282.89	
Second unit	245.98	
Langell Valley	428.16	
Lower Lake	9,147.28	
Pumping plant	2,650.02	
Administrative general expense	24.63	
		124,778.96
Power system:		
Keno Canal	111,329.02	
South Branch Canal power plant	740.10	
McCormick tract	11,424.62	
Leavitt tract	3,415.38	
		126,909.12
Farm units:		
Second unit	2,421.62	
Tule Lake marginal lands	472.42	
Administrative and general expense	180.08	
		3,074.12
Permanent improvements and lands, headquarters site and buildings		18,766.10
Telephone system, construction of line and instruments		26,185.87
Operation and maintenance during construction		24,833.35
Plant account		32,617.63
Operation and maintenance compounded with construction		1,269.95
Gross cost of construction of project to June 30, 1916		2,750,242.54
Less revenues earned during construction period:		
Rental of lands and buildings during operation period	30.00	
Rental of grazing and farming lands	6,812.23	
Rental of irrigation water	31,488.21	
Construction freight refunds	8,555.71	
Other revenues unclassified	858.76	
		47,744.91
Net cost of construction to June 30, 1916		2,702,497.63

Estimated cost of contemplated work on Klamath project during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examination and surveys:		
Stream gaging	$1,500.00	
Surveys, Sand Hollow unit and Upper Klamath Lake	6,730.07	
		$8,230.07
Canal system:		
Sand Hollow unit—		
Flume	7,500.00	
Tunnels	39,040.10	
		46,540.10
Lateral system:		
Marginal unit, excavation and structures	7,300.00	
First unit, excavation and structures	17,142.76	
		24,442.76
Drainage system:		
First unit, excavation and structures	46,724.54	
Second unit, excavation and structures	7,000.00	
Marginal unit, excavation and structures	5,000.00	
		58,724.54
Farm units, surveys marginal lands, Tule Lake		1,457.78
Operation and maintenance under construction:		
Second unit, until Dec. 31, 1916	3,671.19	
Keno power canal	800.00	
Lost River diversion works	400.00	
		4,871.19
Operation and maintenance under public notice:		
First unit	25,300.00	
Second unit, after Jan. 1, 1917	5,000.00	
Marginal unit	8,000.00	
Tule Lake unit, under water rental	5,067.56	
		43,733.56
Total estimated expenditure		180,000.00

SOUTH DAKOTA, BELLE FOURCHE PROJECT.

B. E. HAYDEN, project manager, Newell, S. Dak.

LOCATION.

Counties: Butte and Meade.

Townships: 6 to 10 N., Rs. 3 to 8 E., Black Hills meridian.

Railroads: Chicago & North Western; Chicago, Burlington & Quincy; Chicago, Milwaukee & St. Paul.

Railroad stations and estimated population January 1, 1916: Belle Fourche, 1,100; Newell, 292; Nisland, 128; Fruitdale, 100; Vale, 75.

WATER SUPPLY.

Source of water supply: Belle Fourche River.

Area of drainage basin: 4,265 square miles.

Annual run-off in acre-feet: Belle Fourche River at diversion dam (4,265 square miles), 1903 to 1915—maximum, 554,608; minimum, 119,860; mean, 315,359.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916: 78,591 acres.

Area under water-right applications, season of 1916: 61,313 acres.

Length of irrigation season: May 1 to October 1—152 days.

Average elevation of irrigable area: 2,800 feet above sea level.

Rainfall on irrigable area: 8 years, average, 14.5 inches; 1915, 21.44 inches.

Range of temperature on irrigable area: —38° to 103° F.

Character of soil of irrigable area: North side of Belle Fourche River principally heavy clay soil, with scattered areas of sandy clay loam; south side, sandy loam. All of the soils are heavy enough not to be disturbed by winds.

Principal products: Grain, corn, alfalfa, potatoes, and garden truck.

Principal markets: Omaha, Nebr.; Chicago, Ill.; and mining towns in the Black Hills.

LANDS OPENED FOR IRRIGATION.

Dates of public notices, regulations, and orders relating thereto: June 21, 1907; May 29, 1908; January 18, 1909; February 19 and November 26, 1910; January 24, March 9, May 4, and December 30, 1911; February 3 and May 2, 1912; February 26, June 23, and July 21, 1913; January 19, February 26, May 29, August 14, and September 24, 1914; April 10 and May 18, 1915; March 10, March 16, and July 6, 1916.

Location of lands opened: T. 7 N., Rs. 5 to 7 E.; T. 8 N., Rs. 3 to 7 E.; T. 9 N., Rs. 2 to 6 E.; T. 10 N., Rs. 3 to 6 E., Black Hills meridian.

Present status of lands opened: 30,696 acres entered subject to the reclamation act; 3,781 acres opened to entry; 4,503 acres of State lands; 39,610 acres in private ownership.

Limit of area of farm units: Public, 80 acres; private, 160 acres.

Duty of water: 1.5 acre-feet per acre per annum at the farm.

Building charge per acre of irrigable land: $30, $35, and $40.

Annual operation and maintenance charge: For 1915, 75 cents for first acre-foot of water per acre; additional quantities, 60 cents per acre-foot. For 1916, 90 cents for first acre-foot; additional quantities, 50 cents per acre foot.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys begun in 1903.
Construction recommended by board of engineers April 29, 1904.
Construction authorized by Secretary May 10, 1904.
Diversion dam and inlet canal completed September, 1907.
Belle Fourche Dam completed June, 1911.
First irrigation, season of 1908.
Entire project 93.7 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Belle Fourche project provides for the diversion of water from the Bell Fourche River by means of a dam about 1¼ miles below Belle Fourche, S. Dak., and an inlet or supply canal about 6¼ miles in length into a storage reservoir controlled by the Belle Fourche Dam on Owl Creek, a tributary of the Belle Fourche River; the distribution of water from the inlet canal to a small area of land and the distribution of water from the reservoir through two canal systems to lands on both sides of the Belle Fourche River.

The United States claims all waste, seepage, spring, and percolating waters arising within the project, and proposes to use such water in connection therewith.

The features of the above irrigation plan completed are the diversion dam, headworks, inlet canal, Belle Fourche storage dam, south canal and laterals, north canal and all tributary laterals and structures. The features not yet constructed are Willow Creek and Nine Mile laterals and their tributaries, covering approximately 15,000 acres of land.

SUMMARY OF GENERAL DATA FOR BELLE FOURCHE PROJECT TO JUNE 30, 1916.

Areas:			
Irrigable acreage when project is complete			97,916
Public land entered, June 30, 1916		30,696	
Public land open to entry, June 30, 1916		3,781	
State land, June 30, 1916		4,503	
Private land, June 30, 1916		39,610	
Acreage service could have supplied season of 1915			78,591
Estimated addition in fiscal year 1917			4,600
Acreage actually irrigated, season of 1915			44,067
Acreage cropped under irrigation, season of 1915			43,063
Crops:			
Value of irrigated crops, season of 1915			$462,050.00
Value of irrigated crops per acre cropped			10.72
Finances:			
Estimated cost of completed project			$3,632,781.76
Total construction cost to June 30, 1916			$3,420,551.42
Per cent complete, June 30, 1916			93.70
Appropriation for fiscal year 1917, total			$108,680.00
Allotment for construction, fiscal year 1917			$48,000.00
Estimated per cent complete, June 30, 1917			93.70
Announced construction charges per acre			$30, $35, $40
Appropriation, fiscal year 1916			$144,000.00
Expenditures during fiscal year chargeable to 1916 appropriation—			
Disbursements	$93,917.52		
Transfers	7,200.90		
		$101,118.42	
Registered liabilities chargeable to 1916 appropriation		25,822.79	
			126,941.21
Unencumbered balance, July 1, 1916			17,058.79

Repayments:	
Construction charges—	
Accrued to June 30, 1916	$186,511.33
Collected to June 30, 1916	162,129.41
Uncollected, June 30, 1916	24,381.92
Operation and maintenance charges (public notice)—	
Accrued to June 30, 1916	156,151.43
Collected to June 30, 1916	131,578.15
Uncollected, June 30, 1916	24,573.28
Water rental charges—	
Accrued to June 30, 1916	210.00
Collected to June 30, 1916	210.00
Drainage, estimated acreage damaged by seepage to June 30, 1916	3,000.00

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

DIVERSION DAM AND INLET CANAL.

The diversion dam is located on the Belle Fourche River about 1½ miles below the town of Belle Fourche. It is a concrete weir 23 feet in height and 400 feet long between abutments. From the south abutment an earth embankment, protected by rock paving on the water slope, extends to high ground. Beyond the north abutment are located a sluiceway provided with three double-leaf gates, each 5 feet wide and 10 feet high, and an intake for the inlet canal which is provided with seven gates 5 feet wide and 10 feet high. The crest of the dam is 1 foot above normal water surface elevation of the canal. The dam rests on shale or slate rock, which at this point extends to a great depth.

The inlet canal, constructed for the purpose of diverting water from Belle Fourche River to a storage reservoir on Owl Creek, is 6½ miles long and has a capacity of 1,600 second-feet. It is located on the north bank of the river and extends from the intake in an easterly direction through the divide to Dry Creek, where the water passes by a 10-foot drop into the reservoir. About half a mile below the headworks the canal crosses Crow Creek. It is arranged to take the water of this stream into the canal, and to guard against floods a concrete weir 180 feet long is constructed on the lower bank with a sluiceway in which are installed three gates 5 feet wide and 10 feet high. A short distance below this regulating weir and sluiceway a check is constructed in the canal consisting of a concrete structure provided with six sheet steel gates 6 feet wide and 8 feet high. For the purpose of regulating the flow in the canal and delivering the water to the reservoir without causing serious erosion a concrete weir 183 feet long, discharging into a concrete-lined outlet channel, was constructed at the end of the canal.

In October, 1904, plans for the diversion dam, inlet canal, and structures were completed and approved, and proposals were opened April 10, 1905. A contract for schedule 1, consisting of the structures and appurtenances, was executed April 24, 1905, and a contract for schedule 2, consisting of the excavation of the inlet canal, was executed April 26, 1904. The work of construction was begun in May, 1904, and completed in September, 1907.

The Crow Creek regulating weir and sluiceway were begun in the fall of 1905 and finished in September, 1907.

The reservoir drop was built during June and July, 1907.

The excavation of inlet canal was begun in May, 1905. On account of unfavorable weather conditions in 1905 the progress in excavation was slow. On March 7, 1906, the contractor defaulted and relinquished the work to the United States. A part of the work was readvertised, but as no bids were received the Secretary of the Interior authorized the work to be completed by Government forces. It was finished in September, 1907.

Proposals for furnishing and erecting five combination truss bridges of 72-foot span over the inlet canal were opened May 15, 1906, and a contract was executed June 18, 1906. The bridges were completed in January, 1907.

BELLE FOURCHE DAM.

The Belle Fourche Dam is located on Owl Creek just below its junction with Dry Creek and about 12 miles northeast of Belle Fourche. It is an earth dam 6,493 feet long on top, including wasteway, 115 feet high above cut-off trench at maximum section, 18 feet 7 inches wide on top, and having slopes in general of 2 to 1. On the water face, however, the slope above the water line is 1½ to 1, and for a short distance at the bottom 5 to 1. The elevation of the top of the dam is 2,990 feet above sea level. The dam completed contains 1,546,000 cubic yards of earth and 26,160 cubic yards of masonry and requires 17,820 concrete blocks (6½ by 5 feet and from 6 to 8 inches thick) on the water slope and 15 acres of grass seeding on the lower slope. A wasteway, located in a draw beyond the east end of the dam, has a semicircular concrete weir crest 314 feet long at elevation 2,975 or 15 feet below the top of the dam.

The outlets consist of two concrete conduits through the dam, the floors of which are at elevation 2,920 or about 45 feet above the lowest point of the reservoir. These conduits conduct the water from the reservoir to the North and South Canals. They are controlled by gates, which are operated from gatehouses on the top of concrete shafts built up through the dam near its center line. The outlets are about 2,400 feet apart. They are provided with 58-inch balanced valves at the inlet ends to control the entrance of water.

In July, 1905, plans for the construction of the dam and about 18 miles of the outlet canals were reviewed and approved by a board of engineers consisting of Messrs. Charles E. Wells, J. H. Quinton, C. H. Fitch, and R. F. Walter. Proposals were opened October 26, 1905, and a contract was executed for the entire work, consisting of three schedules. Schedule 1 included the dam and 1¾ miles of the North and South Canals adjacent to it. Schedule 2 included over 8 miles of the North Canal, and schedule 3 included about 8 miles of the South Canal. Work was begun on the dam March 26, 1906, and was completed on June 15, 1911.

NORTH CANAL.

The water required for the irrigation of about 60,000 acres of land north of the Belle Fourche River and east of Owl Creek is supplied through the North Canal. This canal heads at the north outlet conduit in the Belle Fourche Dam and ends at station 2290, where it divides into Willow Creek and Sheffield laterals. The canal should have been completed prior to July 1, 1916, but owing to excessive rains a small amount of work yet remained to be done at the close of the fiscal year.

The canal when completed is approximately 44 miles long and for the most part is a one-bank structure, being a sidehill canal. The banks throughout are 2 to 1 inside and 1½ to 1 outside slope in fill and 1 to 1 in cut.

The first 433 stations, or that portion between Belle Fourche Dam and Indian Creek flume, were built by the contractor for the dam. Work was begun on March 26, 1906, and completed May 21, 1908. Its capacity is 1,600 second-feet from the outlet conduit to the wasteway, which it crosses one-half mile from the dam and at which are located two spillway gates.

Beyond this point the canal will be used entirely for irrigation and has an initial capacity of 650 second-feet, a bottom width of 28 feet, and a water depth of 7 feet. On that portion built by the contractor for the dam, work was begun on March 26, 1906, and finished May 21, 1908. Four main laterals and many more smaller ones take out along this stretch of canal. All turnout structures are of concrete.

During the season of 1911 the North Canal was extended from station 433, a point only a few hundred feet west of Indian Creek flume, to station 1,659, where it emptied temporarily into Deadman Creek. This work comprised the excavation of 765,572 cubic yards of earth, the erection of Indian Creek and Horse Creek flumes, the construction of three wasteways, and the placing of numerous lateral turnout bridges and drainage culverts. The excavation up to station 1,650 was divided into eight schedules and advertised under Specifications No. 173. Bids were opened at Belle Fourche, S. Dak., on February 24, 1911, and awards covering the entire eight schedules were made to four contracting firms. Schedule 9, running from station 1,650 to 1,659, was let to Robert Kinkaid under award of bids opened at Belle Fourche storage dam, September 1, 1911. The object of this short schedule was to complete the canal to a large draw. The price bid averaged about 18½ cents per cubic yard for all excavation. Work was begun early in the season and completed December 15 of the same year.

The canal at Indian Creek has a bottom width of 30 feet, a water depth of 5 feet, and a capacity of 500 second-feet; at station 1,659 the corresponding functions are 18, 5, and 300. These functions, however, vary according to the topography of the country and the material through which the canal is constructed. Through all of this section banks have a 3-foot freeboard and an 8-foot crown width. The gradient used throughout this section was from 0.0003 to 0.00025, but owing to a tendency to scour in the gumbo and shaley materials only about half this amount of fall has been used in later construction.

All structures of whatever nature were built by Government forces.

The Indian Creek flume carries the water of the North Canal across Indian Creek. It is a Hess Toncan metal waterway mounted on a wooden substructure; it is 1,300 feet in length, has a diameter of 10 feet 10 inches and a capacity of 500 second-feet. The intake and outlet structures are concrete warped surfaces. At the upper end of the intake a concrete check is provided to control the flow through the concrete wasteway a few feet upstream. The trestle work rests on concrete piers excavated to blue shale in the sections adjacent to the creek.

Horse Creek flume is similar in design to the Indian Creek flume. It is a Hess Toncan metal flume with a diameter of 10 feet 2 inches and is 676 feet between inlet and outlet head walls. Its capacity is 450 second-feet. Owing to delays in the delivery of material this flume was not completed until the early part of 1912.

At station 431, or about 100 feet above the intake of the Indian Creek flume, a 5 by 5-foot sluice gate and chute is provided for handling excess storm water that finds its way into the canal. The gate opens into a 5 by 5-foot square concrete box which falls 4 feet in 28 feet and then empties into a chute 125 feet long having a drop of 30 feet and discharging on a level with the bed of Indian Creek. This chute is made with 6-inch concrete walls reinforced with one-half inch square steel bars and has concrete baffle posts 18 inches high on the outlet floor.

At stations 688 and 1206+50 concrete waste gates also are provided. There is nothing unusual, however, in the design of these structures.

All main-canal turnouts are of vitrified sewer pipe fitted with screw-stem steel gates set in concrete with concrete outlet. These gates are provided for all laterals and for farm deliveries when made from the main canal.

On account of shortage of funds no extensions were made on the North Canal during 1912, but on May 8, 1913, bids were opened for extending this canal from station 1659 to station 1861 under specifications No. 234 which included the construction of the adjacent lateral system. The North Canal work was divided into two schedules, covering 60,690 and 54,820 cubic yards, respectively. The contractors both began operations the first part of June and had finished before the close of the year.

The canal throughout this entire division has 18-foot bottom width, 8-foot banks, 8-foot crown width, and grade of $s=.00015$.

The only unusual feature was the concrete culvert and waste gate at station 1774 where the drainage for over 3,000 acres lying above the canal is taken care of. The structure is of reinforced concrete with a 48-inch-square cast-iron waste gate from the canal and a drainage culvert under the canal with a cross-sectional area of approximately 36 square feet.

During 1914 the North Canal was extended from station 1861 to station 2127; the first 800 feet of which comprise the Dry Creek flume. Bids were opened on April 15 under specifications No. 260 and contract awarded to the Owen Construction Co., of Denver, Colo., at $0.147 per cubic yard. The excavation comprised a total of 205,594 cubic yards, of which 117,937 cubic yards were on the North Canal and 87,657 cubic yards on laterals. The only unusual feature of this section of canal is the Dry Creek flume which has a Hess galvanized-steel waterway 9 feet 6 inches in diameter built on timber trestle work with 16-foot bents. The posts are of 10 by 10 inch red fir and rest on concrete piers. This structure was built by Government forces.

SOUTH CANAL.

The South Canal is about 45 miles in length and furnishes water for irrigating lands on the north side of the Belle Fourche River west of Owl Creek and on the south side of the river in the vicinity of Vale, S. Dak. The principal structures on the line of the canal are the siphons under the Belle Fourche River, Whitewood Creek, and Anderson Draw, a tunnel 1,306 feet long through a bluff on the south side of the river, and steel flume over Stinking Water Creek.

The first division of the canal, nearly 8 miles in length, extends in a southerly direction from the south conduit of the dam to the Belle Fourche River. It has a capacity at its upper end of 350 second-feet, a bottom width of 18 feet, and a water depth of 5½ feet. As the laterals are taken out the capacity of the canal is gradually decreased. This division was built by the contractor for the dam. The work was begun in April, 1906, and finished June 30, 1907. The construction presented no unusual features, the structures consisting of concrete wasteways and culverts and a reinforced-concrete arch of 22-foot span.

The second division of the South Canal is about 30 miles in length. It crosses to the south side of the Belle Fourche River by a siphon 3,565 feet long and extends in an easterly and southerly direction to a point about 6 miles east of Vale. Proposals were opened April 10, 1907, and all bids were rejected except those for sections 7 and 8, which included 11½ miles of canal in the vicinity of Vale, and for which a contract was executed on May 29, 1907, and the work completed in November, 1907. The balance of the work was readvertised and proposals opened on June 10, 1907. All bids were rejected and authority was granted by the Secretary of the Interior to do the work by Government forces. Satisfactory informal contracts were made, however, for excavation of sections 2, 4, 5, and 6, leaving all of the structures, including the siphons and tunnel, and several miles of open canal to be constructed by Government forces. Work was begun in May, 1907, and all of the canal and structures were completed to Cottonwood Creek, near Vale, in the spring of 1909, and the remaining structures on the canal in the spring of 1910.

The Belle Fourche River siphon is a reinforced-concrete pressure pipe 3,565 feet long, having an internal diameter of 5 feet with an 8-inch shell reinforced with ½-inch and ⅝-inch square bars for a head of 65 feet. Its construction was begun in August, 1907, and completed in October, 1908.

The tunnel is about 2 miles east of the Belle Fourche siphon and carries the South Canal through a high bluff on the south bank of the river. It is 1,306 feet long with a horseshoe-shaped section 9½ feet wide and 10½ feet high and is lined with concrete throughout. Excavation was begun in August, 1907, and completed in May, 1908. The portals were excavated the previous winter by contract. The placing of concrete lining was begun in May and finished in August, 1908.

The Anderson siphon, which carries the South Canal across Anderson Draw under a head of about 45 feet, is of reinforced concrete 8 inches thick and has an internal diameter of 7 feet and a length of 425 feet. It has inlet and outlet chambers and a blow-off with drain. Its construction was begun in the spring of 1908 and finished in September, 1908.

The Whitewood siphon, which carries the South Canal across Whitewood Creek under a head of approximately 15 feet, is a reinforced concrete 8 inches thick and has an internal diameter of 6 feet and a length of 350 feet. The work was begun June 10, 1908, and finished in October, 1908.

LATERALS.

Plans for part of the lateral system north of the Belle Fourche River were made during the winter of 1906-7, and proposals for construction were opened on April 30, 1907. Contracts were executed for the earthwork, but as no bids were received for the structures authority was granted to build them by Government forces. The system under these contracts consisted of the following main laterals:

(1) The Johnson lateral, 16 miles long, taking water directly from the inlet canal above the reservoir and irrigating about 3,000 acres of land on the north bank of the river and west of the South Canal.

(2) The Todd, Miller Butte, and Sorenson laterals, heading in the South Canal and furnishing water for irrigating the land between it and Owl Creek.

(3) The Ross, Gillette, Indian Creek, Gregory, and La Flemme laterals, heading in the North Canal and serving lands east of Owl Creek.

Work was begun on the earthwork contracts in June, 1907, and completed in May, 1908. The building of the structures by Government forces was begun in August, 1907, and those on the South Canal system were completed by June, 1908. Work was then begun on structures for the North Canal laterals and they were completed in the spring of 1909.

Plans for a part of the lateral system of South Canal south of Belle Fourche River and of a part of the Indian Creek laterals north of the river were prepared in the spring of 1908. Proposals were opened on August 20, 1908, and contracts executed. The work was begun in October, 1908, and completed in the following spring.

Plans for the lateral system at the extreme lower end of the South Canal east of Vale were prepared during the winter of 1908-9. Proposals were opened on March 5, 1909, and contracts executed. The work was begun in April and completed in August, 1909. The structures were built by Government forces and were completed in the spring of 1910.

Proposals were opened for the construction of 25 miles of small laterals from the North Canal on August 25, 1909. Satisfactory contracts were made and the work was completed in November, 1909.

During the season of 1910, work on the Nine Mile lateral, which is in fact a continuation of the South Canal beyond the south line of Butte County, was commenced and at the close of the year that portion lying west of Nine Mile Creek was 27 per cent completed. During the following year this section was finished under a number of small contracts and by Government forces. The Nine Mile lateral has been constructed for a distance of 7 miles and extends to the proposed crossing on Nine Mile Creek, where its capacity is 100 second-feet. It is proposed to extend this lateral for about 16 miles in a southeasterly direction to cover an additional 8,000 acres of rich sandy loam country.

In the spring of 1911 contracts were let for the excavation of all of the larger laterals in divisions B and C or that country fed by the North Canal and lying between Indian Creek and Deadman Creek. The price bid ranged from 11 to 14 cents per cubic yard. Government forces were used on the smaller laterals and on all structure work. The largest lateral in this system is known as the town-site lateral.

Its length is approximately 12 miles, and as it passes alongside the town of Newell it is carried in two successive continuous wood-stave pipes 42 inches in diameter. A small amount of work yet remained uncompleted at the close of the season which, together with other small work, is all that was done in the way of construction during the season of 1912.

During the season of 1913 the lateral system under the North Canal was extended to Dry Creek, covering an additional 4,000 acres of land. The three principal laterals were advertised under specifications No. 234 and contracts awarded at from 16 to 19 cents per cubic yard. The largest of these laterals has a bottom width of 4 feet and a length of 4½ miles. All structures and sublaterals were built by Government forces. The total yardage moved was 37,902.

The distributing system under the North Canal was extended during 1914 to include all irrigable land north of the Belle Fourche River as far east as Deer Creek, about 3 miles east of the town of Newell. The two principal laterals, Deer Creek and Antelope, were built by contract under specifications No. 260. All sublaterals and structures were built by Government forces except Deer Creek siphon, constructed by the Washington Pipe & Foundry Co., of Tacoma, Wash., under specifications No. 275. The contract price was $2.85 for the pipe in place. The United States paid all freight and hauling charges. The pipe is 60 inches in diameter, 1,750 feet long, and is constructed of Douglas fir with ⅝-inch steel bands placed 8 inches apart. All work was completed prior to the close of the season.

TELEPHONE SYSTEM.

The telephone system consists in general of three main lines radiating from the Belle Fourche Dam. The first line terminating at Belle Fourche was built by contract in 1905. The second line through Vale via the South Canal was built by Government forces in 1907. The third line through Newell was built in 1911. From these main lines branches have been built to ditch rider's stations, construction camps, and other points as required in the construction and operation of the project. In 1915 a line connecting the Newell and Vale line was constructed. On June 30, 1916, the line consisted of 92.1

miles of permanent single-wire line with 30 poles per mile and 3.7 miles of temporary line. The number of phones operated was 28.

CONSTRUCTION DURING FISCAL YEAR.

North Canal.—On August 27, 1915, bids were opened for excavation work extending the North Canal to station 2242+50. Curtis Bros., of Columbus, Nebr., were the lowest bidders and were awarded the contract at 12½ cents per cubic yard for all classes of excavation. Other bids ranged around 18 and 19 cents per cubic yard for class 1 material. The work advertised included certain lateral construction, which was awarded at the same price. The total contract covered 63,000 cubic yards, of which 40,000 were North Canal excavation and 23,000 were lateral excavation. The contractors began work on October 4 with teams and fresnos; they later put on an elevating grader drawn by traction engine. It was soon found that moving gumbo by this method would not yield a profit at 12½ cents per cubic yard, and work with the grader was discontinued. On April 26, 1916, a drag-line excavator was moved onto the work and was operated without satisfactory results until June 24. On June 30 approximately 34,000 cubic yards of excavation had been moved under this feature of the contract. The contractor's time limit was up on June 1, but on June 30 approximately 20 per cent of the work remained to be done.

The program of work laid out for the fiscal year 1916 contemplated the completion of the North Canal to station 2290, where it branches into Willow Creek and Sheffield laterals. From station 2242+50 to station 2259+15 the work is being done by Government forces and will be ready for operation next season. This section of the canal comprises 210 feet of 62-inch reinforced concrete pipe, two reinforced concrete structures allowing 14½ feet drop in grade, and 1,250 linear feet of open canal, with 10-foot bottom and 6-foot height of bank. Beyond this work, and between station 2257+15 and station 2290, the canal runs through a 60-inch continuous wood-stave pipe of California redwood. This pipe was constructed by the Pacific Tank & Pipe Co., of San Francisco, at a cost to the Government of $3.59 per linear foot. The pipe is supported by redwood cradles resting on concrete bases. Work on this contract was begun on April 26 and was 99 per cent completed on June 30. The intake and outlet as designed are to be of reinforced concrete, and they, together with the concrete footings, were included in the program of construction by Government forces. This work, together with the lateral system, should be completed by August 15, 1916, and will then provide for the irrigation of all land under the project north of the Belle Fourche River as far east as Willow Creek. The only work beyond this point will be the construction of the Willow Creek lateral, which will serve about 7,000 acres of fairly good land.

Lateral system.—Eighteen miles of laterals involving the excavation of 70,000 cubic yards of class 1 material were completed. The size of laterals varied from 10-foot bottom width with 6-foot banks to 2-foot bottom width with 2-foot banks. About 300 minor structures were built. These canals and laterals deliver water to 4,600 acres of land and complete the project to Willow Creek on the north side of the Belle Fourche River.

Contracts were made with Curtis Bros. of Columbus, Nebr., for the construction of all of the principal laterals adjacent to the North Canal. The yardage on these laterals amounted to 22,900 cubic yards and was contracted at 12.5 cents per cubic yard. The time limit for completion was June 1, but on June 30 approximately 40 per cent of the contract remained to be completed.

The Pacific Tank & Pipe Co. was awarded the contract for erecting the North Canal siphon and the Sheffield lateral siphon. The North Canal siphon carries the water across a depression between two hills, a distance of 3,500 feet, and delivers water to the Willow Creek and Sheffield laterals. The siphon is 60 inches in diameter; 3,285 feet are continuous stave pipe constructed of California redwood and 215 feet reinforced concrete.

The Sheffield lateral siphon is a similar continuous wood stave pipe 24 inches in diameter and 450 long, built of California redwood, and is covered with earth.

All sublaterals and structures other than the one mentioned are being built by Government forces. The entire program should be accomplished by August 15 of the present year, when the total irrigable area of the project for which the service can deliver water will be approximately 83,200 acres.

DRAINAGE.

In the Thirteenth Annual Report of the Reclamation Service, under the head of "Drainage," is given a history of irrigation on the project and its effect on seeped land and irrigation requirements. The localities seriously affected by seepage remain the same as those mentioned in that report, but the areas have increased materially. On the newer portions of the project small isolated areas have become waterlogged until the total area on the project now rendered unfit for agriculture on account of seepage is close to 3,000 acres. An effort is now being made by the water users in the south and west portions of the project to have the Reclamation Service take up on a supplemental construction charge the drainage of that section independently of the remainder of the project and to have the costs assessed for repayment subsequent to the regular construction charge. A vote will probably be taken during the calendar year 1916.

OPERATION AND MAINTENANCE.

During the season the first, second, third and fourth units of the project were irrigated. The total irrigable area of these units amounts to 78,591 acres of which 61,313 acres are now under water-right application. Owing to heavy precipitation during the summer season of 1915 only 44,067 acres were irrigated. The area under crop and receiving water during the first half of 1916 is approximately 48,000 acres.

Water was stored in the Belle Fourche Reservoir during the fall of 1915 and the spring of 1916. The maximum storage for the season was recorded on May 10 and amounted to 158,380 acre-feet. On May 10 a severe wind storm, blowing from the northwest and continuing for more than 24 hours, dislodged or seriously affected 366 paving blocks on the face of the Belle Fourche Dam. Temporary repair was made immediately and the lake lowered 10 feet within about a month. Permanent repair has been delayed pending decision as to the best methods to be followed in making the structure storm proof. On June 30 the reservoir contained 96,100 acre-feet of water.

Historical review, Belle Fourche project.

	1911	1912	1913	1914	1915	1916
Acreage for which service was prepared to supply water	47,568	65,852	65,852	68,852	78,591	78,591
Acreage irrigated	19,786	27,897	32,881	37,454	44,067	48,000
Miles of canal operated	295	467	474	488	528	547
Water diverted (acre-feet)	19,155	166,835	124,275	145,284	135,804	....
Water delivered to land (acre-feet)	32,400	30,390	47,349	54,262	16,484	....
Per acre of land irrigated (acre-feet)	1.64	1.10	1.44	1.45	0.37	....

SETTLEMENT.

Settlement on the Belle Fourche project has been light for the past four years. Within that period there have been at all times a number of desirable unoccupied farm units. On June 8, 1915, the fourth unit of the project containing 13,143 acres of irrigable land, of which 10,196 acres were public land, was opened to entry. After the 1st of January, 1916, there was a pronounced demand for this land, and the settlement of the area progressed satisfactorily. On June 30 the total number of unentered farm units on the project was 56.

A few transfers among local people have taken place, but practically no purchases of private land by new settlers have taken place.

Settlement data, Belle Fourche project.

Item.	1914	1915	1916
Total number farms on project	1,292	1,292	1,292
Population	2,360	2,375	2,475
Number of irrigated farms	615	717	767
Operated by owners or managers	401	462	495
Operated by tenants	214	255	272
Population	1,724	1,877	....
Number of towns	5	5	5
Population	2,050	2,060	1,667
Total population in towns and on farms	4,410	4,435	4,142
Number of public schools	23	23	23
Number of churches	11	11	11
Number of banks	10	9	9
Total capital stock	$140,000	$140,000	$140,000
Total amount of deposits	$963,549	$139,386	$1,297,000
Total number of depositors	3,398	3,728	4,228

PRINCIPAL CROPS.

The principal crops are alfalfa, wheat, oats, corn, potatoes, native hay, and small fruits. The small grain crops for the season of 1915 were good, but the corn crop was a partial failure due to the cold and wet season. Alfalfa made good yields, but a large percentage of the crop was damaged by rain. The potato crop was fair.

The total crop outlook for the present season is good although the corn is late and may not mature.

Crop report, Belle Fourche project, South Dakota, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa hay	16,152	Tons	34,842	2.2	$4.50	$156,789	$9.90
Alfalfa seed	284	Bushels	65	.2	10.00	650	2.00
Barley	1,613	...do	47,365	29.3	.65	30,787	19.05
Beans	36	...do	132	3.6	3.00	396	11.00
Beets, sugar	31	Tons	311	10.0	4.00	1,244	40.00
Clover hay	92	...do	170	1.8	4.00	680	7.20
Corn	4,470	Bushels	64,098	14.3	.50	32,049	7.15
Corn fodder	1,866	Tons	1,208	.6	5.00	6,040	3.00
Flax	48	Bushels	408	8.5	1.80	735	15.30
Garden	133					7,690	57.80
Hay	2,782	Tons	2,507	.9	10.00	25,070	9.00
Millet seed	46	Bushels	529	11.5	1.00	529	11.50
Oats	4,440	...do	165,260	37.2	.40	66,104	14.90
Onions	14	...do	1,350	96.4	.80	1,080	77.10
Pasture	3,273					14,105	4.32
Potatoes	161	Bushels	17,984	111.5	.50	8,992	55.75
Rye	135	...do	2,184	16.2	.90	1,966	14.58
Wheat	7,747	...do	133,248	17.2	.80	106,598	13.76
Miscellaneous	89					546	6.13
Less duplicated areas	349						
Total cropped acreage.	[1] 43,063	Total and average				462,050	10.72

Irrigated, not cropped:	
Orchard	52
Young alfalfa—	
With nurse crop	1,472
Without nurse crop	893
Miscellaneous	59
Less duplicated areas	1,472
Total irrigated acreage	44,067

Areas.	Acres.	Farms.	Per cent of project.[2]
Irrigable area farms reported	55,298	717	56.5
Irrigated area farms reported	44,067	717	45.1
Cropped area farms reported	43,063	717	44.0

[1] Includes 7,300 acres hailed out.

[2] Based on 97,916 acres.

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, MARCH 10, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, notice is hereby given that hereafter until further notice for all lands under the Belle Fourche project, South Dakota, the operation and maintenance charge for any irrigation season shall be due and payable on March 1 of the following calendar year.

2. The operation and maintenance charges for the irrigation season of 1916 and for each irrigation season thereafter until further notice, shall be due March 1 of the following year, and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of 90 cents, which will permit delivery of not more than 1 acre-foot per acre, and

should further quantities be needed, they will be furnished at the rate of 50 cents per acre-foot.

3. The provisions of this public notice cover all lands subject to public notice heretofore issued for the said project.

4. Except as hereinbefore provided, all the terms and provisions of existing public notices and orders and in particular the public notice of April 10, 1915, for the Belle Fourche project, shall remain unchanged.

Franklin K. Lane,
Secretary of the Interior.

PUBLIC NOTICE, JULY 6, 1916.

1. Certain lands within the limits of the Belle Fourche project, South Dakota, now subject both to public notice and to trust deeds executed on or before January 24, 1911, have not been included in water-right applications duly filed.

2. Under public notices heretofore issued an increase in building charge from $30 per irrigable acre to $40 per irrigable acre was made effective as to these lands in case of failure to make water-right application within a specified period.

3. In order to afford the owners of these lands an opportunity to file water-right application in accordance with the conditions contemplated by paragraph 4 of the contract between the Secretary of the Interior and the Belle Fourche Valley Water Users' Association, dated January 24, 1911, notice is hereby given that water-right applications will be received from the owners of such lands subject to the provisions of public notices and orders heretofore issued at a charge for building the irrigation works of $30 per irrigable acre.

4. In case water-right applications for such lands are not duly made within one year from the date hereof, the Secretary of the Interior will call upon the Belle Fourche Valley Water Users' Association to execute the provisions of the trust deed in regard to the disposition of said lands at public sale to qualified persons who shall be required to file water-right application.

5. In all cases where water-right application has been made at a building charge of $40 per acre for lands which on or before January 24, 1911, were signed under contract with the Belle Fourche Valley Water Users' Association or held under trust deed by such association, it is hereby ordered that the building charge specified therein shall be reduced to $30 per acre, and appropriate credits shall be made upon the accounts of such water-right applicants.

6. The provisions of public notices and orders heretofore issued are hereby modified as to any provision in conflict herewith.

Andrieus A. Jones,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 733.]

Feature costs of Belle Fourche project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys		$806.09
Storage system:		
Diversion dam	$117,322.76	
Feed canal	333,181.36	
Belle Fourche Dam	1,235,177.32	
		1,685,681.44
Canal system:		
North canal	492,895.20	
South canal	491,346.50	
Administrative expense	1,292.40	
		985,534.10
Lateral system:		
Laterals, division D	118,325.72	
Laterals, division A	252,545.21	
Laterals, division B	129,230.17	
Laterals, division C	67,710.43	
Nine Mile Creek extension	37,360.53	
Willow Creek lateral	789.56	
Administrative expense	1,459.82	
		607,421.44
Drainage system		787.21
Farm units		6,246.64
Permanent improvements and lands:		
Buildings	38,394.04	
Real estate and permanent improvement	54,107.10	
Administrative expense	19.75	
		92,520.89
Telephone system:		
Telephone lines	14,232.04	
Administrative expense	11.41	
		14,243.45
Plant accounts		14,306.99
Operation and maintenance charges transferred to and compounded with construction charges		13,003.17
Gross cost of construction of project to June 30, 1916		3,420,551.42
Less revenues earned during construction period:		
Rental of buildings	4,248.40	
Rental of grazing and farming lands	2,661.90	
Rentals of telephones and tolls	87.48	
Contractors' freight refunds	2,616.22	
Forfeitures by defaulting bidders and contractors	7,337.50	
Sale of town-site lots	54,350.67	
Other revenues, unclassified	45.00	
Profit on mess-house operations	3,459.57	
Profit on mercantile store operations	1,688.16	
Profit on hospital operations	2,133.64	
		71,709.40
Net cost of construction of project to June 30, 1916		3,348,842.02

Estimated cost of contemplated work, Belle Fourche project, during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Storage system, Belle Fourche Dam		$30,000.00
Canal system, North Canal		5,500.00
Lateral system:		
Division D	$4,000.00	
Nine Mile Creek extension	1,500.00	
		5,500.00
Drainage system		3,500.00
Telephone system		500.00
Operation and maintenance		67,000.00
Stores and other operations:		
Mess-house operations	1,500.00	
Hospitals	500.00	
		2,000.00
Total		114,000.00

UTAH, STRAWBERRY VALLEY PROJECT.

J. L. LYTEL, project manager, Provo, Utah.

LOCATION.

Counties: Utah and Wasatch.

Townships: 8 and 9 S., Rs. 1 to 3 E., Salt Lake base and meridian.

Railroads: Denver & Rio Grande; Salt Lake Route.

Railroad stations and estimated population June 30, 1916: Payson, 3,000; Spanish Fork, 3,600; Springville, 3,700; Provo, 10,500.

WATER SUPPLY.

Source of water supply: Strawberry and Spanish Fork Rivers and a number of small streams and springs not on the watersheds of these two. Contemplated pumping plants.

Area of drainage basins: Strawberry River, including Indian and Trail Hollow Creeks, 175 square miles; Spanish Fork River, 670 square miles.

Annual run-off in acre-feet: Strawberry River in Strawberry Valley, including Indian and Trail Hollow Creeks, 1903–1906 and 1909–1915, maximum, 150,000; minimum, 49,000; mean, 77,500. Spanish Fork River at Spanish Fork, 1903–1915, maximum, 227,000; minimum, 65,000; mean, 117,500.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the servicce is prepared to supply water during the season of 1916: 50,000 acres; 235,000 acre-feet available in reservoir.

Length of irrigating season: April 15 to September 30—169 days.

Average elevation of irrigable area: 4,600 feet above sea level.

Rainfall on irrigable area: At Provo, average, 19 years, 14.2 inches; 1915, 17 inches.

Rainfall at Strawberry Reservoir: Average, 3 years, 21.4 inches; 1915, 18.6 inches.

Range of temperature on irrigable area: —10° to 95°; mean temperature at Provo, 49° F.

Character of soil on irrigable area: Sandy loam, heavy clay, and varying mixture of both; black alluvium; loam; and gravel. Much of the soil is underlaid by a coarse gravel, and the natural drainage is excellent.

Principal products: Alfalfa, hay, cereals, sugar beets, fruits, vegetables.

Principal markets: Salt Lake City, Utah, and adjacent towns and mining districts.

LANDS OPENED FOR IRRIGATION BY PUBLIC NOTICE.

	Acres.
Spanish Fork unit, Oct. 9, 1915, and May 9, 1916	24, 290
Lake Shore unit, Oct. 8, 1915, and May 9, 1916	5, 580
High Line unit, May 13, 1916	16, 980
Total	46, 850

In addition to this the service has contracted[1] to sell to the Clinton, Soldier Fork, and Diamond Fork districts a total of about 860 acre-feet of water per annum.

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[1] Contracts not approved July 1, 1916, but water will be delivered, as all necessary charges have been paid by applicants.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys begun in 1903.
Construction recommended by Board of Engineers October 2, 1905.
Construction authorized by Secretary December 15, 1905.
Excavation of tunnel completed June 20, 1912.
Storing of water in Strawberry Reservoir begun July 14, 1912.
Construction of Indian Creek Dike completed September, 1912.
Strawberry Tunnel formally opened September 13, 1913.
Construction of Strawberry Dam completed September 20, 1913.
Construction started on High Line Canal January, 1915.
First storage water used for irrigation June 27, 1915.
Divisions 1 to 9, distribution system, practically completed December 31, 1915.
Water turned down High Line Canal and used for irrigation April 17, 1916.
High Line Canal turned over to water users April 24, 1916.
Project as a whole 91 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Strawberry Valley project provides for the storage of water in a reservoir on the Strawberry River; the discharge of the stored water through the Strawberry Tunnel, approximately 3¾ miles long, into Diamond Fork, a tributary of the Spanish Fork River; and the diversion of water from the Spanish Fork River into canal systems, watering lands east and south of Utah Lake, in Utah County. A hydroelectric plant on the south side of the river supplies power for construction and commercial purposes. Part of the power developed may be used ultimately for pumping water for irrigation of high lands and drainage of low lands. The United States claims all waste, seepage, unappropriated spring and percolating water arising within the project, and purposes to use such water in connection therewith.

On the High Line unit, where an area of 25,000 acres, the greater part of which at present has no water right, will be irrigated, a complete canal system will be constructed by the United States, and on the Spanish Fork and Lake Shore units, where a supplementary supply will be furnished for a large acreage, the existing canal systems will be used. Any necessary enlargements or extensions will be made by the water users comprising the various canal companies, for according to the terms of the contract between the United States and the canal companies, the responsibility of the United States ends with the delivery of the water at the heads of the various canals. In the case of the Soldier Fork, Diamond Fork, and Clinton districts, water belonging to appropriators below the confluence of Diamond Fork with the Spanish Fork River is used by persons above this point, and an equal amount of water is released from the Strawberry Reservoir for the benefit of the prior appropriators. The water users build all of the ditches and other irrigation structures themselves.

The completed features of the irrigation plan are: Diversion dam on Spanish Fork River; power canal; the first unit of the hydroelectric power plant on the Spanish Fork River; Strawberry Tunnel, through the rim of the Great Basin; all of the canal system on the High Line unit, except a portion of the canals and laterals irrigating Goshen Valley and the land between the west side of West Mountain and Utah Lake—and the following features in connection with the Strawberry Reservoir: Strawberry Dam, Indian Creek Dike, Indian Creek and Trail Hollow diversion canals and appurtenant structures, and the East Portal permanent camp. In connection with the construction of these features 55 miles of wagon road, 44 miles of telephone lines, and 49.5 miles of high-tension power-transmission lines have been built. Power from the United States Reclamation Service power house is being supplied to Payson, Salem, and Spanish Fork for lighting and commercial purposes. The United States built the high-tension lines from the power house to these towns; the towns built their own substations and distribution lines.

In accordance with the present plans, the work remaining to be done on the project consists of the completion of the High Line Canal distribution system in Goshen Valley and such minor structures and extensions on the storage works, power canal, and that portion of the High Line Canal and distribution system, now nominally completed, as may be found necessary. The Mapleton lateral may be constructed in case the landowners under that unit sign up enough land to warrant the expenditure. It is improbable, however, that this will be done during the coming fiscal year.

No construction work will be done on the Spanish Fork or Lake Shore units, as the contracts with the canal companies on these units provide that the water from the project shall be delivered to the head of the several existing canals, and the companies shall deliver it from this point to the land.

SUMMARY OF GENERAL DATA FOR STRAWBERRY VALLEY PROJECT TO JUNE 30, 1916.

Areas:			
Irrigable acreage when project is complete			50,000
Public land withdrawn, June 30, 1916		3,500	
Private land, June 30, 1916		46,500	
Acreage service could have supplied season of 1915			22,500
Addition in fiscal year 1916			14,000
Estimated addition in fiscal year, 1917			10,000
Estimated acreage service can supply July 1, 1917			46,500
Acreage actually irrigated, season of 1915			7,000
Acreage cropped under irrigation, season of 1915			7,000
Finances:			
Estimated cost of completed project			$3,650,000.00
Total construction cost to June 30, 1916			$3,192,949.74
Per cent complete, June 30, 1916			91
Appropriation for fiscal year 1917, total			$315,000.00
Allotment for construction, fiscal year 1917			$232,000.00
Estimated per cent complete, June 30, 1917			93.90
Announced construction charges per acre—			
High Line unit			$80.00
Foot Spanish Fork unit			90.00
Appropriation, fiscal year 1916		$393,000.00	
Increase under 10 per cent provision of act		39,300.00	
Total appropriation			432,300.00
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$358,822.74		
Transfers	19,101.72		
		$377,924.46	
Registered liabilities chargeable to 1916 appropriation		12,231.23	
Contract obligations wholly covered by 1916 appropriation		29,466.48	
			419,622.17
Unencumbered balance, July 1, 1916			12,677.83
Repayments:			
Construction charges—			
Accrued to June 30, 1916			20,420.76
Collected to June 30, 1916			19,828.95
Uncollected, June 30, 1916			591,81
Operation and maintenance charges (public notice)—			
Accrued to June 30, 1916			5,441.59
Collected to June 30, 1916			5,352.03
Uncollected, June 30, 1916			89.56
Water rental charges—			
Accrued to June 30, 1916			678.00
Collected to June 30, 1916			678.00

Power earnings—	
Accrued to June 30, 1916	$36, 502. 72
Collected to June 30, 1916	35, 423. 92
Uncollected, June 30, 1916	1, 078. 80

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

STORAGE WORK.

Strawberry Reservoir.—The storage works of the Strawberry Valley project consist of the Strawberry Reservoir and its appurtenant structures—the Strawberry Dam, Indian Creek Dike, Indian Creek and Trail Hollow Diversion Canals, and the Strawberry Tunnel.

The Strawberry Dam is situated in the canyon of the Strawberry River, just below the Strawberry Valley. Indian Creek Dike is located in the saddle between the Indian Creek and Strawberry Valleys. These two structures close the only two openings in the rim of the Strawberry Valley and thus form the Strawberry Reservoir, with a capacity of 286,000 acre-feet and an area of 8,300 acres. The high-water elevation of the reservoir is 7,558 feet above sea level. The top of the dam and dike is 11 feet above high-water level, or at an elevation of 7,569 feet; the elevation of the river bed at the Strawberry Dam is 7,497 feet and the sill of the intake at the east portal is at elevation 7,517.

The waters of Trail Hollow, Indian Creek, and Horse Creek are diverted from their natural course through Indian Creek Valley and are carried in the feeder canals around the end of Indian Creek Dike and into the reservoir. The Strawberry River and its tributaries flow directly into the reservoir. An outlet to the reservoir is formed by the Strawberry Tunnel approximately 3¾ miles long, through the rim of the great basin.

General conditions.—Construction camps were established by the Government at the west (or outlet) portal and east (or inlet) portal of Strawberry Tunnel, and also at Strawberry Dam, as these features were constructed by Government forces. Indian Creek Dike and the diversion canals were built by contract and the contractors established camps near the various features of the work.

Diamond Switch, the nearest point on the railroad, is 23 miles from west portal, 29 miles from east portal, and 33 miles from Strawberry Dam, and lies at elevation 5,000. The elevation of the pass, where the road crosses the rim of the Great Basin (between east and west portals) is 8,400 feet. All machinery and supplies had to be hauled from Diamond Switch by wagon.

Owing to the high altitude, the construction season was confined to about five months and the roads were nearly impassable at times during those five months. These two items, shortness of construction season and difficulty of obtaining material and supplies, greatly handicapped the work at all times. Owing to the extremely cold weather during the winter it was necessary to thoroughly waterproof all concrete structures.

WAGON ROADS.

During the summer and fall of 1906 a wagon road 30 miles long, extending from Diamond Switch, the United States Reclamation

Service shipping point on the Denver & Rio Grande Railway, to both portals of the tunnel was constructed by Government forces. The road follows Diamond Fork Canyon for 16 miles, and on this section a great deal of difficult rockwork was necessary that increased the cost of the road and greatly reduced progress.

Since 1910 approximately 25 miles of wagon roads have been built to connect the various features under construction in Strawberry Valley. A road was built from Mile Post 27 on Diamond Fork Road, down Horse Creek Canyon to Strawberry Dam, a distance of 6 miles. From a point on this road near Indian Creek Dike a road was built around the end of the reservoir to the east portal, a distance of approximately 4½ miles. This road, which was constructed above the high water level of the reservoir, was necessary because the old road between the dam and east portal was completely submerged when the reservoir was filled with water.

A road was also constructed from the wasteway bridge at Strawberry Dam to a point on the Heber-Vernal Road, approximately 5 miles distant. A portion of the Heber-Vernal Road, approximately 4 miles long, had to be relocated above the high-water level. The road from the east portal along the west side of Strawberry Valley to the Heber-Vernal Road was improved by a little grading and the construction of numerous cross culverts and bridges. At the present time, therefore, it is possible to drive completely around the Strawberry Reservoir. The road is used by the traveling public, range rider, gage reader, and men in charge of the operation and maintenance of the structures in Strawberry Valley.

Certain portions of Diamond Fork Road below the west portal were relocated at higher elevations, as the old road was destroyed by the storage waters from the Strawberry Tunnel.

Four light timber truss bridges were constructed along Diamond Fork Road at points where small bridges were made impassable by the increased flow of Diamond Fork. Such maintenance work has been done from year to year as was required to keep the road in suitable condition.

TELEPHONE AND TRANSMISSION LINES.

A telephone line, approximately 38 miles in length, was built by contract from Spanish Fork to the east portal of the Strawberry Tunnel. The line was begun in June and completed during the latter part of November, 1906.

In addition to the main telephone line from Spanish Fork, several short service lines have been constructed by Government forces.

A power-transmission line, extending from the power house in Spanish Fork Canyon to the west portal of Strawberry Tunnel, was constructed by contract during the summer of 1908. The location of the line and the engineering work were begun in 1907, but were stopped when work was suspended at the tunnel in July of that year. In the spring of 1908 the location was resumed and completed, and a contract for the erection of the line was entered into with a local contractor. Construction work was begun April 1 and the line was completed September 1, 1908.

During October and November, 1909, a transmission line, 3½ miles long, was constructed from the power house to Spanish Fork for the purpose of supplying that city with electric current for lighting and other purposes.

The telephone and transmission lines were extended from the west portal of the Strawberry Tunnel, a distance of 4 miles, during the fiscal year 1911. During the fiscal year 1912 these same lines were extended from the east portal to the Strawberry Dam via Indian Creek Dike, a distance of 7 miles. The object of extending these lines was to provide communication between the various features and to furnish power for the operation of the various features at east portal and the dam. On the completion of Strawberry Dam the transmission line was dismantled between that feature and Diamond Switch. The telephone line to east portal and Strawberry Dam is now used in connection with the operation and maintenance of all structures comprising the storage works, and especially the regulation of the flow of stored water through the tunnel during the irrigation season.

DIVERSION DAM AND CANAL HEADWORKS.

Spanish Fork Dam is located on the Spanish Fork River and was constructed for the purpose of diverting 500 second-feet of water into the power canal. All work on the dam was done by Government forces except the hauling of cement, which was done by contract. The dam is constructed of rubble concrete, is 16 feet in height above the bed of the stream, and has a 40-foot overflow weir, with two sluice gates 5 feet wide by 10 feet high. Excavating for the foundation of the dam was commenced in October, 1907, and the concrete work was completed July 1, 1908.

The intake to the power canal was constructed at one end of the dam on a hard, blue limestone foundation. The water enters the canal through six openings, 4½ feet by 8 feet. The sills of these openings are 2 feet above the top of the sluice gates so that only the top or clearer part of the water is drawn into the canal. Before it enters the canal the water passes at slow velocity through a double-compartment sand box in which the heavier particles of silt are deposited. The sediment is sluiced from the bottom of the sand box through seven 12-inch round valves. This arrangement at the intake is made necessary by the fact that Spanish Fork River carries a heavy load of suspended matter when at high-water stage.

POWER CANAL.

The power canal takes 500 second-feet of water from Spanish Fork River at the diversion dam and conveys it 3¼ miles along the foot of the mountains to the intake of the high-line canal. At this point 250 second-feet of water are turned into the high-line canal, 60 second-feet are diverted with a fall of 127 feet through the power house into the Salem Canal, and the remaining 190 second-feet are diverted with a fall of 166 feet through the lower power house into Spanish Fork River.

Construction of the power canal by Government forces was authorized on December 4, 1906; work was begun in May, 1907, and pursued with all possible diligence until October 1, 1907; a small force was employed on the excavation of tunnel No. 1 during the winter of

1907–8. The excavation was completed and the concrete work commenced in the spring of 1908. Water was first turned into the canal December 13 and through the pressure pipe December 15, 1908.

A reenforced concrete aqueduct extends from station 47+07 to station 54+57 on the power canal. It is 750 feet long, and the alignment contains a number of curves.

Tunnel No. 1 on the power canal is 800 feet long and extends from station 6 to station 14, the alignment being straight. The tunnel was excavated to a 10-foot by 11½-foot section, the dimensions inside the 12-inch concrete lining being 8 feet by 7 feet, with an arched roof having a 2½-foot rise. The tunnel has a capacity of 500 second-feet, estimated from a velocity of 9 feet per second, and a slope of 1.6 feet in 1,000 feet.

Excavation was commenced on the tunnel July 1, 1907, and completed February 29, 1908, and the lining was placed in May and June, 1908.

Tunnel No. 2 extends from station 725 on the power canal a distance of 705 feet, its alignment having curves at both ends. This tunnel has the same section as tunnel No. 1 and is lined throughout with concrete 12 inches thick. Work was commenced on this tunnel June 15 and completed October 9, 1907.

At the end of the power canal concrete diversion works provide a waste weir and wasteway channel, an intake for a high-line canal, and a power-house intake. These structures are built on a foundation composed of sandy, silty material, and the concrete is heavily reenforced throughout.

Approximately 1,000 feet of the power canal was covered, partly with reinforced concrete arch and partly with reinforced concrete slab and girder coverings, to prevent the canal from being filled with rock from disintegrating slopes and with débris from numerous snowslides that occur in the vicinity of Garfield Canyon, mile 1 on the main power and distribution canal. In October and November, 1913, the power canal was cleaned of silt and débris.

POWER PLANT.

A hydroelectric power plant in Spanish Fork Canyon, with sufficient installation to develop 1,200 horsepower, was built primarily for the purpose of furnishing power for construction purposes on the project.

The transmission line and the pressure pipe were constructed under contract. The remainder of the installation and construction was accomplished by Government forces.

The excavation for the power house was commenced May 19, and finished June 6, 1908.

Concrete work was commenced June 17 and finished July 7, 1908.

Work on the power plant superstructure was commenced July 17, and the main part of the carpenter work was finished September 6, though the interior was not completed until about December 1, 1908.

The work of installation was begun August 5, when the main gate valves were raised into position, and the major part of the installation was completed by November 10, although a small amount of work was in progress up to December 15, 1908.

Work on the pressure pipe was commenced September 1 and completed November 23, 1908.

Water was first turned into the pressure pipe December 15, 1908. The transmission line was energized for the first time on January 7, 1909, when the motor-generator set at the substation was started and run for about two hours, and on January 8 the air compressor was started. On January 15 the operation of the whole power system was begun.

During 1913 the power plant was completely overhauled and such new parts added as were necessary to place the plant on an efficient basis.

STRAWBERRY TUNNEL.

Strawberry Tunnel brings water from the Colorado River drainage basin through the divide into the Great Basin. It pierces the mountains at a depth of 1,400 feet, has a total length of 19,897 feet, and is lined throughout with concrete. The west or lower portal of the tunnel is 7,452 feet and the east portal 7,508 feet above sea level. The tunnel has a capacity of 600 second-feet; a slope of 3 feet in 1,000; and a section excavated 9 feet wide by 10½ feet high but with dimensions inside the concrete lining of 7 feet wide by 6½ feet high on the sides with an arched roof having a 2-foot rise.

Preliminary investigation of the location of the tunnel line was made during the summer of 1905. Proposals to be opened August 30, 1906, for the construction of the tunnel were advertised for, but none were received, and the work of excavation from both portals by Government forces was authorized by the Secretary of the Interior.

A substantial camp was constructed at the west portal of the tunnel during the months of September, October, and November, 1906. A small power house was constructed and electric drills were installed in the heading. These drills were furnished with power by small direct-current motors driven by gasoline engines. This temporary installation was for the purpose of opening up the tunnel in order that the nature of the material that would be encountered might be shown. Work was continued with two shifts during the winter of 1906 and 1907, fair progress being made. The material encountered in the heading was limestone of medium hardness that disintegrated slowly on exposure to the air. Timbering sets 8 inches square, placed from 3 to 6 feet on centers and lagged overhead, were put in for the entire distance excavated. On July 20, 1907, after 1,565 feet of tunnel had been excavated, work was suspended to await the development of electric power, and the camp was left in the care of two watchmen.

Nothing more was done on this feature until September 1, 1908, when the installation of a power plant or substation to be used in the construction of the tunnel was begun at the lower portal. By December 9 a well equipped modern, electrically operated plant had been installed, with ample power to supply compressed air for drills in the heading and electric current for lighting and power purposes. The work at the heading was resumed on December 9, 1908.

The excavation of the tunnel was carried on during succeeding years until the bore was finally completed in June, 1912. In driving the tunnel the material encountered varied from hard limestone to soft sandstone and shale. The sandstone and shale for the most part carried considerable water and disintegrated rapidly when exposed to air. This condition made it necessary to timber the tunnel very carefully in order to protect the workmen. During the latter part of December, 1910, a flow of approximately 7 second-feet of water was encountered near station 105+00. This flow continued throughout the construction of the tunnel and greatly increased both the work and cost of driving. In all, approximately 70,000 cubic yards of material were excavated in driving the tunnel.

During the summer of 1910 a crushing and concrete-mixing plant was installed near the mouth of the tunnel, and in October of the same year the work of lining the tunnel with concrete was commenced. This work was carried on continuously until completed in November, 1912. In all, approximately 25,000 cubic yards of concrete were placed in the tunnel lining.

An appropriate portal was constructed of concrete at the western extremity of the tunnel and at a point approximately 150 feet from this structure a reinforced concrete barrier weir was built. The object of this weir was to prevent the cutting back of the rock and undermining of the tunnel proper. This weir also enables the water from Strawberry Tunnel to be measured accurately up to a discharge of 200 second-feet. For the purpose of measuring larger quantities of water a reinforced concrete measuring flume 20 feet wide and 150 feet long has been constructed at a point 2 miles below the west portal of the tunnel. On the completion of the Strawberry Tunnel all camp buildings at the west portal were sold to private parties, who now use the camp as a summer resort.

East portal.—The work on this feature was started in October, 1911, and carried on by three shifts until June 20, 1912, when the two headings met. A construction plant consisting of substation and blacksmith, carpenter, and machine shops, was established and equipped with all necessary tools and machinery. The necessary camp buildings were also built and furnished.

In connection with the inlet work of the Strawberry Tunnel, a shaft was made at station 182+00 extending from the tunnel to the ground surface above maximum high water. At the foot of the shaft two 3 by 5 feet gates were installed for delivery of water at minimum level of the reservoir and two additional gates to be used in case of emergency. Two other gates were installed in the shaft at higher elevations for delivery of water at various heights of the reservoir.

The mechanism for operating these gates is contained in a reinforced concrete gatehouse situated at the top of the shaft. The mechanism can be operated either by means of a hydraulic turbine located near the bottom of the tunnel, or by a hand power winch in the gatehouse. The intake to the tunnel, a reinforced concrete structure consisting of rack bars supported by a system of columns and beams, is situated 1,600 feet from the shaft, or at station 198+00 and at elevation 7,517.

The actual tunnel excavation extended 900 feet beyond the shaft, or to station 191+00 and from that point to the intake, a circular reinforced concrete "cut and cover" section was constructed.

Beyond the intake structure there is an earth channel 1,300 feet long, which enables water to be withdrawn from the reservoir to elevation 7,517.

After the completion of the Strawberry Tunnel and the inlet works, it was necessary to construct a permanent camp for the two men who are stationed at the east portal for the entire year for the purpose of taking care of all the structures in the vicinity of the storage works. Two 4-room cottages were constructed of concrete and cement and plaster, and wooden buildings from the old construction camp were used as warehouses, stables, etc. The 10-acre tract of land on which these buildings stand was fenced, and a pipe line was run to a neighboring spring to provide water. Some grading was done adjacent to the buildings and the entire camp made suitable for the operation and maintenance of all structures connected with the storage works.

The Strawberry Tunnel, as finally completed, is 19,897 feet long, has a slope of 3 feet per thousand, is concrete lined throughout, and has a rated capacity of 600 second-feet. Water was first turned through the tunnel (for a few hours only) on September 13, 1912, and water from the reservoir was first used for irrigation purposes on June 27, 1915. Approximately 3 miles of the tunnel were driven from the west end and one-half mile from the east end.

STRAWBERRY DAM.

Work on this feature was begun on June 18, 1911. The dam site was first stripped, and a sluicing tunnel built around the north end of the dam to divert the river during the construction of the earth embankment. Camp buildings, storehouses, and barns were erected. A rock-crushing and concrete-mixing plant was installed and a cableway built for transporting rock and concrete between the plant and various features of the work. A water system was put in for camp and construction purposes. The dam is earth filled, 72 feet high above the original stream bed, with a reinforced-concrete core wall extending 69 feet above the stream bed and from 10 to 25 feet into bedrock.

The upstream slope is three to one and is protected by 24 inches of crushed stone, overlaid by 12 inches of rock paving. The downstream slope is two to one and is protected with a layer of crushed rock extending to within 20 feet of the top of the dam. The crest of the dam is 21 feet wide, protected on the water side by a 4-foot berm.

Around the north end of the dam is a sluicing tunnel at the elevation of the river bed. The flow through this tunnel is controlled by means of two 4 by 6 foot gates, operated through a shaft extending to the ground surface above maximum high water and driven by means of a horse whim. A 60-foot spillway with crest at elevation 7,558 has been provided at the north end of the dam. The water from the reservoir discharges over this spillway and is conveyed through a concrete-lined wasteway to a point 550 feet beyond the dam.

A four-span reinforced-concrete bridge was constructed across the wasteway to permit public travel across the top of the dam. The Strawberry dam is 500 feet long, 72 feet high, and contains approximately 110,000 cubic yards of material. Construction work, except for the lining of the wasteway, was completed in September, 1913.

INDIAN CREEK DIKE.

The type of construction at Indian Creek Dike was similar in all respects to that employed at the Strawberry Dam. During the excavation of the core-wall trench a bed of quicksand was encountered which necessitated the use of sheet piling driven to a depth of from 15 to 20 feet to provide suitable foundation for the core wall. The dike, as completed, is 1,310 feet long, 37 feet maximum height, and contains approximately 100,000 cubic yards of material. The construction work, which was done by contract, was commenced in July, 1911, and completed in September, 1912.

INDIAN CREEK AND TRAIL HOLLOW FEEDER CANALS.

Indian Creek Canal diverts the water of Indian Creek from a point in Indian Creek Valley around the end of Indian Creek Dike into the Strawberry Reservoir. It is 2 miles long, has a bottom width of 22 feet, a capacity of 750 second-feet, and is unlined. At the point of diversion there is a concrete structure providing inlet gates, sluice gates, and spillway so that the water of Indian Creek may be diverted into the canal or allowed to follow its original channel, as desired.

At the point of discharge into the reservoir, there is a concrete notch drop and lined chute to guard against all erosion and possibility of ultimate damage to the Indian Creek Dike. Two wooden truss bridges span the canal at points where it is intersected by roads.

Trail Hollow Canal diverts the water of Trail Hollow Creek into Indian Creek above the diversion point of Indian Creek. The canal is 4 miles long, has a bottom width of 12 feet, a capacity of 125 second-feet, and is unlined. At the point of diversion there is a concrete structure providing inlet gates, sluice gates, and spillway; no special structure is necessary at the point of discharge into Indian Creek. The canal is spanned by 3 reinforced concrete bridges.

Owing to the small discharge of Trail Hollow Creek during the winter, it is necessary to turn the water out of the canal and then shovel the accumulated snow and ice from the canal before the spring run off. Indian Creek Canal requires no special maintenance.

Work on the canals was done by contract. It was started in September 1911 and completed in November 1912. A small amount of trimming and other work was done by Government forces during the summer of 1913.

CONSTRUCTION DURING FISCAL YEAR.

High Line Canal and lateral system.—All work on the High Line Canal and lateral system which was started during the fiscal year 1915 was completed about the middle of the fiscal year. The main High Line Canal (divisions 1 to 4 inclusive) is 17.6 miles long, of which 9.5 miles are unlined earth canal, 6.8 miles concrete lined, and the remaining 1.3 miles concrete flumes or covered conduits, wooden flumes, and one short tunnel. The capacity of the canal varies from 300 second-feet at the upper end to 150 second-feet at the lower end. About 150 structures, most of them of reinforced concrete, were built in connection with the High Line Canal. These structures include bridges, culverts, turnouts, checks, flumes, covered conduits, siphons, spillways, cross-drainage siphons, etc.

The capacities of the various laterals and sublaterals vary from 6 to 70 second-feet. The total length of all laterals and sublaterals constructed to date is about 43 miles, 37 miles of which are concrete lined. About 750 reinforced concrete structures were built in connection with this lateral system. The average total force employed by the contractors on the 9 divisions was about 600 men and 275 head of stock; the Government force, including engineers and inspectors, comprised about 125 men and 30 horses.

Bids for the construction of the remainder of the lateral system, division 10, consisting of 24 miles of concrete-lined laterals and sublaterals along the west side of West Mountain and in Goshen Valley have been opened, and it is expected that the work will be completed during the first half of the fiscal year 1917.

POWER PLANT, POWER CANAL, AND TRANSMISSION LINES.

These features were operated practically without interruption, and power was supplied under contract to Payson, Salem, Spanish Fork, and a few isolated persons. The load on the plant has been rather light during the year, owing to the fact that no other sales of power were considered desirable until after the irrigation water that has been developed by the project has been disposed of, and it is known what quantity of water from storage can be used in the development of power.

OPERATION AND MAINTENANCE.

The several complete features in the vicinity of the storage works and the power canal were operated without any unusual trouble, one ditch rider and one gate tender taking care of the storage works and one ditch rider taking care of the Spanish Fork Diversion Dam and power canal.

A total of 8,900 acres was irrigated during the season of 1915. This acreage was divided into about 455 parcels, or "farm units," each unit generally representing a farmer and his family. All of the land irrigated was under the Lake Shore and Spanish Fork units and the Clinton District; no stored water was delivered to the High Line Canal for irrigation purposes during the season of 1915.

The High Line Canal was turned over to the water users on April 24, 1916, and on June 30, 1916, there were approved water-right applications as follows: High Line unit, 442 applications covering 16,506.84 acres at 2 acre-feet each, a total of 33,013.68 acre-feet; Spanish Fork unit, 375 applications covering 6,183.60 acres at ½, 1, 1½, or 2 acre-feet, a total of 7,185.97 acre-feet; Lake Shore unit, 93 applications covering 1,842.28 acres at ½, 1, 1½, or 2 acre-feet, a total of 1,858.85 acre-feet; Clinton,[1] Soldier Fork,[1] and Diamond Fork[1] districts, 869.4 acre-feet, making a total of 42,927.90 acre-feet of water which will be delivered by the United States during the season of 1916.

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[1] Not approved July 1, 1916, but water will be delivered, as all necessary charges have been paid by applicants.

By the terms of the contracts with the various canal companies the United States delivers the water at the heads of the various canals and is not further concerned with its delivery. Each canal has its own water master and ditch riders who are responsible for the distribution of the water to the individual water users.

On June 30, 1916, there were 228,000 acre-feet of water available in the Strawberry Reservoir.

SURVEYS AND INVESTIGATIONS.

Hydrographic work was carried on for the purpose of keeping up the record of the flow of all streams that in any way are connected with the water supply for the project. Fifty gauging stations were maintained and approximately 300 meter measurements made. During the irrigating season one hydrographer was stationed at the Strawberry Tunnel to regulate and keep a record of the flow through the tunnel. The general hydrographer kept a careful record of the amount of water delivered to the various canal companies.

All necessary engineering work, both field and office, in connection with the construction of the High Line Canal and distribution system was done as required. Plans and specifications for division 10 were prepared and printed. Many new water-right applications, and transfers of old applications, were received, and on these all necessary engineering and legal work was done. The farm-unit plats for the High Line, Lake Shore, and Spanish Fort units were prepared and printed.

WATER USERS' ASSOCIATION.

During the past year negotiations have been carried on with all the units and districts on the project with the result that contracts have been concluded and water is being supplied to all except the Mapleton unit.

High Line unit.—On this unit water-right applications have been accepted and placed of record covering approximately 16,500 acres of irrigable land. The main canal and lateral system for supplying water to the entire acreage signed up was completed during the latter part of the calendar year 1915 and delivery of irrigation water was commenced during the latter part of April, 1916. This unit was opened under public notice issued May 13, 1916.

In accordance with article 7 of the water-right application, the water users under the High Line unit have formed an organization and incorporated under the laws of the State for the purpose of operating and maintaining the canal and lateral system and distributing water on the High Line unit at their own expense. This organization is known as the Strawberry High Line Canal Co., and on April 7, 1916, the following contract was entered into by this company, under which they took over the operation and maintenance of the High Line unit:

FEBRUARY 19, 1916.

This agreement made April 7, 1916, in pursuance of the act of Congress of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplementary thereto, between the United States of America, its successors and assigns, by J. L. Lytel, project manager, United States Reclamation Service, subject to the approval of the comptroller or Director of the Reclamation Service, and Strawberry High Line Canal Company, a corporation duly organized under the laws of the State of Utah, with its principal place of business at Payson, Utah, hereinafter styled the "Company," its successors and assigns, witnesseth:

Whereas the United States, in pursuance of the reclamation law, has constructed canals and laterals for the irrigation of lands within the High Line unit of the Strawberry Valley project, the boundaries of said High Line unit being shown on the map attached hereto and made a part hereof;

And whereas the landowners within the said High Line unit, in contracting with the United States for a water right for their respective lands, agree to operate and maintain the canals, laterals, and irrigation structures of the High Line unit as constructed by the United States at their own expense and under their own form of organization;

And whereas the Company has been formed for so operating and maintaining the High Line unit, the stockholders of the Company being owners of land within the said High Line unit;

Now, therefore, in consideration of the premises, it is agreed:

1. The United States will on April 20, 1916, deliver to the Company possession of the canals, laterals, irrigation structures and appurtenances of the said High Line unit as shown on the map attached hereto and made a part hereof. Such possession of the Company is to extend no further than may be necessary to enable the Company to operate and maintain said High Line unit in accordance with the terms of this contract.

2. The Company hereby accepts such possession of said canals, laterals, irrigation structures and appurtenances, and further agrees to operate and maintain them in such a manner that they shall be at all times in good order and working condition, and shall enforce at all times rules for their operation and upkeep, satisfactory to the Secretary of the Interior.

3. The Company will keep a careful and accurate record of all water received, carried, and distributed through the High Line Canal system. The Company will also keep a reasonably accurate record of the crops raised on the unit, and also a modern set of books showing all financial transactions of the Company. The Company may, so far as the United States is concerned, refuse the delivery of water to any stockholder of the company who is in default in the payment of assessments or other charges due the Company or who refuses to comply with reasonable regulations of the Company that have been approved by the Secretary of the Interior.

4. The Company will deliver to all landowners of the High Line unit who are stockholders of the Company the water supply which the said landowners are entitled to receive (*a*) under the regulations of the Company approved by the Secretary of the Interior, and (*b*) under existing Government water-right applications and public notices and the water-right applications hereafter made and public notices hereafter issued under the provisions of the reclamation laws. Deliveries made by the Company will be in accordance with such water-right applications and public notices and not otherwise. The Company will use all reasonable diligence to secure an economical use of water so delivered to its stockholders. But there is reserved the right to the United States to secure proper deliveries of water to each individual water-right applicant at the expense of the water users of said High Line unit in case the Company fails to provide for proper distribution.

5. The Company shall perform promptly any and all repairs which the officer of the United States Reclamation Service having supervision over the Strawberry Valley project shall deem necessary for the proper operation and maintenance of the said canal system and the canal system shall be inspected from time to time as the chief engineer of the Reclamation Service shall deem necessary, such inspection to be made by some competent engineer designated for that purpose by the said officer. The cost of this inspection will be charged to the water users and paid to the United States in the same manner and at the same time as the other charges paid by the water users. In case of failure of the Company to make any repairs deemed necessary by the said officer in charge, then he shall have the power to cause such work to be done and charge the expense thereof to the water users. In case the canal, due to any cause whatever, is found to be in a condition unfit to carry water, the inspecting officer may order the water turned out of the canal until such time as the canal is put in proper condition for service. The United States does not assume any liability for injury of or damage to any person or property incident to the operation of the High Line Canal, laterals, irrigation structures, and appurtenances by the Company.

6. The water for the High Line unit will be delivered in the head of the High Line Canal, which is located in the southeast quarter of section 33, township 8 south, range 3 east, during the irrigation season of May 1st to October 1st of each year in accordance with the terms of existing contracts and public notices and future contracts and public notices. No water will be carried in the High Line Canal system during the period from November 1st to March 31st, inclusive, without the written permission of the chief engineer of the United States Reclamation Service first obtained.

7. The United States shall not be liable for failure to supply water under this contract caused by hostile diversion, unusual drought, interruption of service made necessary by repairs, damages caused by floods, unlawful acts, or unavoidable accidents.

8. The canal system has been constructed for the purpose of carrying water that has been purchased from the United States Reclamation Service, by the landowners on the High Line unit, and shall not be used by the Company for carrying water from any other source unless written permission is secured from the United States.

9. The Company shall be responsible for all property and equipment turned over to it in connection with the operation of the canal system of the High Line unit, and any damage to property of loss of equipment while in its possession shall be paid by the Company to the United States upon demand from the proper officer of the United States.

10. In accordance with the terms of this contract the United States will deliver water for the High Line unit into the head of the High Line Canal, such water being taken from the supply of the Government Strawberry Valley project. Inasmuch as it requires from fifteen to twenty hours for stored water to flow from the Strawberry Reservoir to the intake of the High Line Canal, a considerable amount of water will be in transit at all times when stored water is being used on the lands of the High Line unit, and the Company will therefore when such stored water is being delivered, notify the United States at least twenty-four hours in advance of the time it wishes water turned off. In case it becomes necessary to turn the water out of the canal without previous notice to the United States, the loss of the water that is in transit between the reservoir and the head of the High Line Canal shall be borne by the canal company, except in cases where the shutting off of the water is due to causes over which the Company has no control, in which case the loss shall be borne equally by the United States and the Company.

11. The Company shall furnish bond in the penal sum of $20,000, conditioned upon the faithful performance by the Company of all covenants and stipulations in the contract, and the sureties on such bond shall be liable up to the full amount of the bond to reimburse the United States for any loss, liability, or damage resulting to the United States by reason of the failure of the Company to discharge any obligations devolving upon it under or by virtue of this contract. If, during the continuance of the contract, any of the sureties in the opinion of the comptroller become irresponsible, additional sureties shall be furnished to the satisfaction of the United States.

12. This contract may at the option of the Secretary of the Interior be terminated at any time upon giving six months written notice to the Company.

13. No Member of or Delegate to Congress, or Resident Commissioner, after his election or appointment or either before or after he has qualified and during his continuance in office, and no officer, agent or employee of the Government, shall be admitted to any share or part of this contract or agreement, or to any benefit to arise thereupon. Nothing however, herein contained shall be construed to extend to any incorporated company, where such contract or agreement is made for the general benefit of such incorporation or company, as provided in section 116, of the act of Congress approved March 4, 1909 (35 Stat., 1109).

In testimony whereof the parties hereto have signed their names this seventh day of April, 1916, the Company acting in pursuance of a duly adopted resolution of its board of directors, certified copy of which is attached.

UNITED STATES OF AMERICA,
By J. L. LYTEL, *Project Manager.*
[SEAL.] STRAWBERRY HIGH LINE CANAL COMPANY,
By JONATHAN S. PAIGE, Jr., *President.*
JUSTIN A. LOVELESS, *Its Secretary.*

AFFIDAVIT OF DISINTERESTEDNESS.

STATE OF UTAH, *county of Utah, ss:*

I do solemnly swear (or affirm) that the copy of contract hereto annexed is an exact copy of a contract made by me, personally, with Strawberry High Line Canal Company, that I made the same fairly without any benefit or advantage to myself, or allowing any such benefit or advantage corruptly to the said Strawberry High Line Canal Company or to any other person or persons; and that the papers accompanying include all those relating to the said contract, as required by the statute in such case made and provided.

J. L. LYTEL,
Project Manager, U. S. R. S.

Subscribed and sworn to before me at Provo, Utah, this 21st day of April, A. D. 1916.

[SEAL.]

JNO. L. SEGALL,
Notary Public.

My commission expires May 22, 1918.

On motion of Director Charles H. White, duly seconded, and carried by unanimous vote, the following resolution was adopted.

Whereas the Strawberry High Line Canal Co. has been organized for the purpose (among others) of receiving from the United States the canal known as the High Line Canal of the Strawberry Valley project, together with the lateral and sublateral ditches, headgates, appliances and appurtenances connected therewith; and also of receiving and distributing through said canal the water belonging to the stockholders of said company in accordance with the laws of Congress relating thereto; and

Whereas a contract has been prepared, and is now presented to this company by the representatives of the United States, which provides for the formal acceptance by the company of the said canal and the responsibilities as therein set forth in detail; Now, therefore, be it

Resolved by the board of directors of the Strawberry High Line Canal Co., That the president and secretary be, and they are hereby, authorized and instructed to execute and deliver said contract and to take all steps necessary to carry into effect the provisions of said laws of Congress, in so far as the same relate in any manner to the acceptance of the said contract or any of its responsibilities * * *.

I, Justin A. Loveless, Secretary of the Strawberry High Line Canal Co., do hereby certify and declare that the above is a full, true, and correct copy of a resolution adopted by the board of directors of said Strawberry High Line Canal Co., at a meeting of said board, held at Payson, Utah, on April 7, 1916.

[SEAL.] JUSTIN A. LOVELESS, *Secretary.*

As the reclamation-extension act was passed after the water-right application for this unit was approved by the secretary during the latter part of 1914, a new form of water-right application was approved on May 27, 1915, as follows:

[Form B.]

Approved by Assistant Secretary, May 27, 1915.

High Line Unit, Strawberry Valley project.

Department of the Interior.

WATER-RIGHT APPLICATION FOR LANDS IN PRIVATE OWNERSHIP AND LANDS OTHER THAN HOMESTEADS UNDER THE RECLAMATION ACT

Act June 17, 1902 (32 Stat., 388); act Aug. 9, 1912 (37 Stat., 265); act Aug. 13, 1914 (38 Stat., 686).

Strawberry Valley project. Serial No. ——

State of Utah. High Line unit.

——————————
(Date.)

1. I, ——————————————————
in pursuance of the provisions of the reclamation act approved June 17, 1902 (32 Stat., 388), and acts amendatory thereof, and supplemental thereto, espe-

cially the act approved August 9, 1912 (37 Stat., 265), and act approved August 13, 1914 (38 Stat., 686), all hereinafter called the reclamation law and the rules and regulations established thereunder, do hereby apply for a water right for the irrigation of and to be appurtenant to the irrigable land as shown on plats to be approved by the Secretary of the Interior within the tract described as follows:

---

containing a total area of ______ acres. Total irrigable area, ______ acres.

2. The quantitative measure of the water right hereby applied for is that quantity of water which shall be beneficially used for the irrigation of said irrigable lands up to, but not exceeding, two (2) acre-feet per acre per annum, measured at the head of the High Line Canal; and in no case exceeding the share, proportionate to irrigable acreage, of the water supply actually available as determined by the project manager or other proper officer of the United States, or of its successors in the control of the project, during the irrigation season for the irrigation of lands under said unit. The said water shall be delivered at the head of the High Line Canal during the irrigation season from May 1 to October 1 of each year in a flow as nearly uniform as practicable, unless otherwise mutually agreed, and will be distributed throughout the months of the irrigation season in accordance with the schedule of delivery adopted by the Secretary of the Interior for the High Line unit. The applicant assumes all risk of loss in transporting the water from the point of delivery to the said lands.

3. I, on behalf of myself, my heirs, executors, administrators, and assigns, hereby promise, covenant, and agree: (a) To pay promptly when due each and every one of the annual installments of the construction charge fixed by the Secretary of the Interior in public notice to be issued in connection with the High Line unit, being $80.00 per acre of irrigable land, payable in the manner provided for in section 1 of the reclamation extension act, and in addition thereto each and every annual charge for operation and maintenance, including any and all expense due to the exercise by the United States, or its successors in control of said unit, of the right reserved in paragraph 7 to secure proper delivery of water to individual water-right applicants under said unit, as fixed from time to time by the Secretary of the Interior or the proper officer of the successors of the United States in the control of the project; (*b*) that each and all of the annual installments of the construction charge, and each and all of said annual charges for operation and maintenance, and each and every penalty attaching under the act of August 13, 1914 (38 Stat., 686), above mentioned, shall be, and the same are hereby, made a mortgage lien, upon the tract of land above described, and upon all water rights now or hereafter appurtenant or belonging thereto, and all improvements now existing or hereafter made thereon, for myself, my heirs, executors, administrators, and assigns, promising, covenanting, and agreeing to pay all taxes and other claims now or hereafter becoming a prior encumbrance, failing which, upon demand by any proper officer of the United States, or its successors in control of said project, the United States or its said successors may pay the same and add the amount thereof to the mortgage lien hereby created, and recover the amount so paid as part of the said lien.

4. Upon my failure to comply with the terms of the reclamation law, and the regulations thereunder, this application may, in the discretion of the Secretary of the Interior, be canceled by him with the forfeiture of all rights under the reclamation law and of all moneys theretofore paid hereon; excepting, however, from the force and effect of this paragraph any and every failure to make payments which shall become due and payable after the issuance of final certificate for the water right hereby sought unler the reclamation law, a remedy for the failure thus excepted having been provided by said law.

5. This application must bear the certificate, as hereto attached, of the water users' association under said project, which has entered into contract with the Secretary of the Interior, and the liens which the United States holds against the above-described land for the payment of the construction, and the operation and maintenance charges, may be enforced, at the option of the United States, either directly by the United States or, where any such lien was given directly to the water users' association for the benefit of the United States, may be enforced through the medium of the water users' association; but the election of one remedy shall not preclude the United States from following the other. If the Secretary of the Interior has made no contract with a water users' association under said project, the applicant agrees to file, upon

his direction, evidence of membership in the water users' association organized under the said project, in default of which this application shall be subject to cancellation by the Secretary of the Interior, with the forfeiture of all rights acquired thereunder and of all payments made thereon.

6. And I further promise, covenant, and agree for myself, my heirs, executors, administrators, and assigns that if any freehold interest in said tract shall, through the voluntary act of me or them, be acquired by any person not qualified by the reclamation law to purchase the water right hereby sought, this application and any such freehold interest shall be subject to forfeiture as provided by said law.

7. It is understood that at their own expense the water users under said unit are to operate and maintain the High Line Canal and distributing system, and deliver water to the lands thereunder, but there is reserved the right to the United States to secure proper deliveries of water to each individual water-right applicant at the expense of the water users of said unit in case of failure to provide for proper distribution, and I hereby promise, covenant, and agree for myself, my heirs, executors, administrators, and assigns that the United States and its successors in charge of the said unit may assume full control over all ditches, gates, and other structures owned or controlled by the applicant or his successors in interest, and which may be required to secure proper delivery of water to any individual water-right applicant; and proper officers and employees of the United States, and its succesors, shall have at all times the right of access to the above-described premises whenever it is, in the judgment of the officer or employee in charge of said unit, necessary for them to secure such delivery of water to exercise said control. And I for myself, my heirs, executors, arministrators, and asigns do hereby give, grant, bargain, sell, and convey to the United States and its said successors the right for any such proper officer or employee to go and come upon any and all lands now or hereafter owned or held by me or them for said purpose and there exercise said control.

8. It is understood and agreed that the United States reserves the right upon my failure or the failure of my successors in interest to keep and perform any of the provisions in this instrument contained, by me and my successors in interest undertaken to be kept and performed, to refuse to deliver water to said lands or to stop the delivery of water thereto if water is being delivered, and such refusal to deliver or stoppage of delivery of water shall not operate to cancel this application, but shall be considered as an additional remedy to the United States to any remedies existing by reason of the provisions of this application or otherwise.

9. And I, for myself, heirs, executors, administrators, and assigns do hereby grant, bargain, sell, convey, and confirm to the United States of America and its successors in charge of the project, all rights of way for ditches, canals, flumes, pipe lines, telegraph and telephone transmission lines, or other structures, now constructed by or under the authority of the United States for or in connection with the said project, and all rights of way that may be or become necessary and suitable, and that may be required for the prosecution and operation of the said project, and for the construction, maintenance, and operation of ditches, canals, flumes, pipe lines, telegraph and telephone transmission lines, or other structures that may be costructed by or under authority of the United States and its successors in charge of the project for and in connection with said project, excepting, however, the right of way required for the construction of the main canal of the project, not including its laterals, to have and hold the same, together with all the tenements, hereditaments, privileges, and appurtenances thereunto belonging or in anywise appertaining to the United States of America and its assigns and successors in charge of the project forever, subject notwithstanding to the conditions upon which this application is made. And I furthermore, for myself, heirs, executors, administrators, and assigns, do hereby convey, quitclaim, and release unto the United States of America and its successors in charge of the project the right to take, appropriate, and use all seepage and waste water arising or flowing from said described land, not heretofore appropriated and beneficially used.

10. No Member of or Delegate to Congress or Resident Commissioner, after his election or appointment or either before or after he has qualified and during his continuance in office, shall be admitted to any share or part of this contract or agreement, or to any benefit to arise thereupon. Nothing, however, herein contained shall be construed to extend to any incorporated company, where

such contract or agreement is made for the general benefit of such corporation or company as provided in section 116 of the act of Congress approved March 4, 1909 (35 Stat., 1109).

11. And I, the said --------------------, being duly sworn, depose and say that my post-office address is --------------------; that I am a bona fide resident upon said land (or occupant thereof, residing in the neighborhood, namely, upon section ------, township ------, range ------, ---------- meridian, a distance in a direct line of ------ miles therefrom); that I hold the following interest in the said tract: -------------------- as duly shown upon the records of -------------------- County, ----------, in volume (liber) ------, at page (folio) ------; that no other application, now uncanceled, has been made for a water right under the reclamation law, appurtenant to land now owned or claimed by me, except as follows:

Application No. ------, -------------------- project, of -------------------- for -------------------- section ------, township ------, range ------, ---------- meridian, an area of ------ acres and containing ------ acres of irrigable land, as determined by the Secretary of the Interior; and that the present application is made in my own behalf and not at the instance or for the benefit of any other person or any association or corporation, either directly or indirectly.

12. Nothing in this application contained shall be construed as in any manner or at all abridging, limiting, or depriving the United States of any means of enforcing any remedy in law or equity for the breach of any of the provisions of this application which it would otherwise have.

In witness whereof, I, --------------------, have hereunto set my hand and seal -------------------- this ------ day of ----------, 191--.

-------------------------------- [SEAL.]
-------------------------------- [SEAL.]

ACKNOWLEDGMENT.

STATE OF UTAH, *County of Utah, ss:*

On this ------ day of ----------, A. D. 1915, personally appeared before me --------------------, the signer of the above instrument, who duly acknowledged to me that he executed the same.

--------------------------------,
Notary Public.

My commission expires ----------.

STATE OF ----------, *County of* ----------, *ss:*

--------------------, being duly sworn, deposes and says that he is the person (or one of the persons) who signed the foregoing instrument; that he has read the same and knows the contents thereof, and that all the statements of fact made by him in said instrument are true of his own knowledge except such as are made upon information and belief, and as to those he believes them to be true.

Subscribed and sworn to before me this ------ day of ----------, 191--.

--------------------------------,
Notary Public.

My commission expires ----------.

--------------------------------, 191--.

I hereby certify that the applicant signing the above instrument has duly subscribed (or is the successor in interest of one who has subscribed) for the stock of this association for the lands described therein, and that all assessments levied against said stock by this association have been fully paid up to date.

--------------------------------,
Secretary ---------- *Water Users' Association.*

Approved and accepted this ------ day of ----------, 191--, by authority of the Secretary of the Interior.

--------------------------------,
Project Manager.

Spanish Fork unit.—During the latter part of the irrigation season of 1915 water-right applications were received and water delivered to approximately 6,200 acres on this unit. A contract was recently entered into with the Salem Canal Co. whereby this company agrees to take and deliver to its stockholders any water that they may purchase from the Strawberry Valley project. The area under this canal will be added to the Spanish Fork unit and water sold to it under the same conditions, the same form of water-right application being used in signing up the land.

Contracts have now been made with all the five existing canals on the Spanish Fork River, and any landowner on the Spanish Fork unit can purchase water from the Strawberry Valley project, and the canal company supplying water to the area in which the land is located will take the water so purchased at the head of the canal and deliver it to his land.

The latter part of the irrigation season of 1916 was extremely dry and the prompt conclusion of negotiations and delivery of water saved the grain and beet crops on the unit. This unit was opened under public notice dated October 9, 1915.

Lake Shore unit.—Water right applications have been executed for more than 1,840 acres in this unit and additional applications are coming in. The unit was opened under public notice dated October 8, 1915.

The operation and maintenance charges for the season of 1915 on all units were promptly paid, the greater part of the water users taking advantage of the discount.

Clinton district.—This district is located on one of the branches of the Spanish Fork River about 8 miles above where the water from the Strawberry Reservoir which flows down Diamond Fork, flows into the Spanish Fork River, and in order that they might receive the benefits of an additional water supply from the project, the farmers of this district entered into a contract with the canal companies that divert water from the lower part of the Spanish Fork River on the Spanish Fork unit and who have appropriated the entire low flow of the Spanish Fork River, whereby the landowners of the Clinton district are permitted to divert a certain part or all of the low flow of the Spanish Fork River from the upper tributaries on condition that the Clinton district farmers purchase an equal amount of water from the Strawberry Valley project, to be turned into the Spanish Fork River in place of the amount they divert, for the use of the canal companies.

The contract for the sale of water to the Clinton district has been approved by the department and is being signed by the water users.

Mapleton unit.—On account of the failure of the landowners on this unit to execute water-right applications covering sufficient acreage to warrant the building of the lateral necessary to supply them with water, the construction work on this unit has been indefinitely postponed.

GRAZING LANDS.

The 60,160 acres of grazing land in the Strawberry Valley were leased to sheepmen during the year; the gross income amounted to about $10,000. The final payment for this grazing land has been made, as provided by law, and the land is now a part of the Strawberry Valley project. Of this area approximately 8,000 acres are at present covered by the waters of the Strawberry Reservoir.

During the latter part of the calendar year 1915 bids for a new lease on the grazing lands were opened with the result that the entire tract is now leased to the Heber Horse and Cattle Growers' Association of Heber and the Wallsburg Livestock Association of Wallsburg, Utah, for a term of five years for $16,750 per annum. Deducting the rebate to the lessees for the land covered by the waters of the Strawberry Reservoir, the net income for the next five years will be approximately $14,500 per annum. There are at present about 1,100 head of horses and 16,000 head of sheep being grazed on this land.

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, OCTOBER 8, 1915.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water is available from the Strawberry Valley project, Utah, for the irrigation season ending September 30, 1915, and for each irrigation season thereafter, in accordance with (*a*) the terms of the form of water-right application for the Lake Shore unit, approved by the Secretary of the Interior December 23, 1914, (*b*) the contract dated October 12, 1914, between the United States and the Lake Shore Irrigation Co., which contract was filed for record January 11, 1915, and duly recorded in book 150, page 425, of the records of Utah County, Utah, and (*c*) the contract of August 30, 1915, between the United States and said company amending the contract of October 12, 1914, for the irrigable lands in the Lake Shore unit, shown on the accompanying list of lands in the following townships, viz, Salt Lake base and meridian, township 7 south, range 2 east; township 8 south, ranges 1 and 2 east, approved by the Secretary of the Interior on October 4, 1915, and on file in the office of the project manager, United States Reclamation Service, Provo, Utah, and in the local land office at Salt Lake City, Utah.

2. Water-right applications for the lands in private ownership may be made to the project manager, United States Reclamation Service, Provo, Utah, at once. The limit of area for which water-right application may be made for lands in private ownership shall be 160 acres of irrigable land for each landowner. Water-right applications may be made for one-half acre-foot per acre, 1 acre-foot per acre, 1½ acre-feet per acre, or 2 acre-feet per acre, as the applicant may desire.

3. The water-right charges for said lands shall be of two kinds: (*a*) A charge for the building of the irrigation system, termed the construction charge, due and payable as hereinafter provided, being (1) $22.50 per irrigable acre when application is made for one-half of 1 acre-foot of water per irrigable acre, (2) $45 per irrigable acre, when application is made for 1 acre-foot of water per irrigable acre, (3) $67.50 per irrigable acre when application is made for 1½ acre-feet of water per irrigable acre, and (4) $90 per irrigable acre when application is made for 2 acre-feet of water per irrigable acre; and (*b*) an annual charge for operation and maintenance due December 1

of each year for the preceding irrigation season. The operation and maintenance charge for the irrigation season of 1915 shall be due December 1, 1915, and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of 55 cents, which will permit delivery of not more than 1 acre-foot per acre, but not more in any case than the amount per acre specified in the water-right application. Should water be needed in excess of 1 acre-foot, when the water-right application provides for more than that amount, it will be furnished at the rate of 55 cents per acre-foot.

4. Five per cent of the construction charge, called the initial installment, shall be paid at the time of making water-right application. The remainder of the construction charge shall be paid in 15 annual installments, the first 5 of which shall each be 5 per cent of the construction charge and the remaining 10 installments each 7 per cent thereof, until the entire construction charge shall have been paid. The first of said annual installments shall become due and payable on December 1 of the fifth calendar year after the initial installment and subsequent installments shall become due on December 1 of each calendar year thereafter.

5. In all cases where water-right application for lands in private ownership, or for lands under entries not subject to the reclamation act, shall not be made within one year after the date of this notice, the construction charge for such land shall be increased 5 per cent each year until water-right application is made and an initial payment is paid.

6. Any water-right applicant may, if he so elects, pay the whole or any part of the construction charge owing by him within any shorter period than that provided by the public notices and orders applicable to his land.

7. All water-right charges must be paid at the office of the United States Reclamation Service at Denver, Colo. Drafts on New York or Denver, or money orders, etc., should be made payable to the disbursing officer, United States Reclamation Service, Denver, Colo.

8. The method of determining the annual operation and maintenance charge, and the penalties for failure to pay the construction charge and the operation and maintenance charges when due, and discount allowed for prepayment of operation and maintenance charges are prescribed by the act of August 13, 1914.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, OCTOBER 9, 1915.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water is available from the Strawberry Valley project, Utah, for the irrigation season ending September 30, 1915, and for each irrigation season thereafter, in accordance with (*a*) the terms of the form of water-right application for the Spanish Fork unit, approved by the Secretary of the Interior March 17, 1915, and (*b*) the

contracts of the dates shown below, as duly recorded in the records of Utah County, Utah, between the United States and the following canal companies: Spanish Fork South Irrigation Co., March 22, 1915; Spanish Fork West Field Irrigation Co., March 25, 1915; Spanish Fork East Bench Irrigation & Manufacturing Co., March 25, 1915; Spanish Fork Southeast Irrigation Co., April 10, 1915; for the irrigable lands in the Spanish Fork unit, shown on farm unit plats of the following townships: Salt Lake base and meridian, township 7 south, range 2 east; township 8 south, ranges 1 east, 2 east, and 3 east, approved by the Secretary of the Interior on October 4, 1915, and on file in the office of the project manager, United States Reclamation Service, Provo, Utah, and in the local land office at Salt Lake City, Utah.

2. Water-right applications for the lands in private ownership may be made to the project manager, United States Reclamation Service, Provo, Utah, at once. The limit of area for which water-right application may be made for lands in private ownership shall be 160 acres of irrigable land for each landowner. Water-right applications may be made for one-half acre-foot per acre, 1 acre-foot per acre, 1½ acre-feet per acre, or 2 acre-feet per acre, as the applicant may desire.

3. The water-right charges for said lands shall be of two kinds: (*a*) A charge for the building of the irrigation system, termed the construction charge, due and payable as hereinafter provided, being (1) $22.50 per irrigable acre when application is made for one-half of 1 acre-foot of water per irrigable acre, (2) $45 per irrigable acre when application as made for 1 acre-foot of water per irrigable acre, (3) $67.50 per irrigable acre when application is made for 1½ acre-feet of water per irrigable acre, and (4) $90 per irrigable acre when application is made for 2 acre-feet of water per irrigable acre; and (*b*) an annual charge for operation and maintenance due December 1 of each year for the preceding irrigation season. The operation and maintenance charge for the irrigation season of 1915 shall be due December 1, 1915, and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of 55 cents, which will permit delivery of not more than 1 acre-foot per acre, but not more in any case than the amount per acre specified in the water-right application. Should water be needed in excess of 1 acre-foot, when the water-right application provides for more than that amount, it will be furnished at the rate of 55 cents per acre-foot.

4. Five per cent of the construction charge, called the initial installment, shall be paid at the time of making water-right application. The remainder of the construction charge shall be paid in 15 annual installments, the first 5 of which shall each be 5 per cent of the construction charge and the remaining 10 installments each 7 per cent thereof, until the entire construction charge shall have been paid. The first of said annual installments shall become due and payable on December 1 of the fifth calendar year after the initial installment and subsequent installments shall become due on December 1 of each calendar year thereafter.

5. In all cases where water-right application for lands in private ownership, or for lands under entries not subject tc the reclamation

act, shall not be made within one year after the date of this notice, the construction charge for such land shall be increased 5 per cent each year until water-right application is made and an initial installment is paid.

6. Any water-right applicant may, if he so elects, pay the whole or any part of the construction charge owing by him within any shorter period than that provided by the public notices and orders applicable to his land.

7. All water-right charges must be paid at the office of the United States Reclamation Service at Denver, Colo. Drafts on New York or Denver, or money orders, etc., should be made payable to the disbursing officer, United States Reclamation Service, Denver, Colo.

8. The method of determining the annual operation and maintenance charge, and the penalties for failure to pay the construction charge and the operation and maintenance charges when due, and discount allowed for prepayment of operation and maintenance charges, are prescribed by the act of August 13, 1914.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, MAY 9, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, notice is hereby given that hereafter until further notice for all lands under the Spanish Fork and Lake Shore units, Strawberry Valley project, Utah, the operation and maintenance charge for any irrigation season shall be due and payable on December 1 of each year for the preceding irrigation season.

2. For the irrigation season of 1916 and thereafter each season until further notice, each acre of irrigable land under said units, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of 40 cents, which will permit delivery of not more than 1 acre-foot per acre, and should further quantities be needed, they will be furnished at the rate of 40 cents per acre-foot.

3. The provisions of this public notice cover all lands subject to public notice heretofore issued for the said units.

4. Except as hereinabove provided, all the terms and provisions of existing public notices and orders and in particular the public notices of October 8 and 9, 1915, for the said units, shall remain unchanged.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, MAY 13, 1916.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water is available from the Strawberry Valley project, Utah, for the irri-

gation season of 1916, and for each irrigation season thereafter, in accordance with the terms of the forms of water-right application for the High Line unit, approved by the Secretary of the Interior February 24, 1914, and May 27, 1915, respectively, for the irrigable lands in the High Line unit, shown on the accompanying plats of lands in the following townships, viz, Salt Lake base and meridian, T. 8 S., Rs. 1, 2, and 3 E.; T. 9 S., Rs. 1, 2 and 3 E.; T. 10 S., R. 1, E., approved by the Secretary of the Interior on May 13, 1916, and on file in the office of the project manager, United States Reclamation Service, Provo, Utah, and in the local land office at Salt Lake City, Utah.

2. Water-right applications for the lands in private ownership may be made to the project manager, United States Reclamation Service, Provo, Utah, at once on the form of water-right application approved May 27, 1915. The limit of area for which water-right application may be made for lands in private ownership shall be 160 acres of irrigable land for each landowner.

3. The water-right charges for said land shall be of two kinds: (*a*) A charge for the building of the irrigation system, termed the construction charge, due and payable as hereinafter provided, being $80 per irrigable acre; and (*b*) an annual charge for operation and maintenance due December 1 of each year for the preceding irrigation season. The operation and maintenance charge for the irrigation season of 1916 shall be due on December 1, 1916, and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of 80 cents.

4. For all water-right applications made on or before August 13, 1914, the installments of the construction charge in the amounts fixed in the form of application approved by the department on February 24, 1914, shall become due on December 1 of each year hereafter, the first of said installments being due on December 1, 1916: *Provided*, *however*, That any of such applicants may render his lands subject to the act of August 13, 1914 (38 Stat., 686), upon filing, within six months after the date hereof, notice of acceptance of said act of August 13, 1914, such acceptance to be duly executed upon the forms for that purpose approved by the department and accompanied by recording fees. For all water-right applications made on or before August 13, 1914, in connection with which such acceptances are duly filed, the installments of the construction charge shall become due on the dates and in the amounts required by section 2 of the said act of Congress of August 13, 1914, the first installment being due and payable on December 1, 1916. For all water-right applications made after August 13, 1914, 5 per cent of the construction charge, called the initial installment, shall be paid at the time of making water-right application, and the remainder of the construction charge shall be paid in 15 annual installments, the first five of which shall each be 5 per cent of the construction charge and the remainder each 7 per cent thereof, until the whole amount shall have been paid. The first of said annual installments after the initial installment shall become due and payable on December 1 of the fifth calendar year after the initial installment, and subsequent installments shall become due on December 1 of each calendar year thereafter.

5. In all cases where water-right application for lands in private ownership shall not be made within one year after the date of this notice, the construction charge for such land shall be increased 5 per cent each year until water-right application is made and an initial payment is paid.

6. Any water-right applicant may if he so elects, pay the whole or any part of the construction charge owing by him within any shorter period than that provided by the public notices and orders applicable to his land.

7. All water-right charges must be paid at the office of the United States Reclamation Service at Provo, Utah, or to such representative of the United States as may be hereafter designated. Until further notice drafts on New York or Denver, or money orders, etc., should be made payable to the special fiscal agent, United States Reclamation Service, Provo, Utah.

8. The method of determining the annual operation and maintenance charge and the penalties for failure to pay the construction charge and the operation and maintenance charges when due and discount allowed for prepayment of operation and maintenance charges are prescribed by the act of August 13, 1914.

9. The regulation is hereby established that until further notice water will be delivered by the United States for the lands within the High Line unit in accordance with the following schedule of delivery: May, 24 per cent of the total annual amount to be delivered to the High Line unit; June 1 to 15, inclusive, 15 per cent of said annual total; June 16 to September 30, inclusive, the remaining 61 per cent; no more, however, than 30½ per cent of said annual total to be delivered in any one month during the period from June 16 to September 30, inclusive. This regulation is subject to modification or change from time to time as the Secretary of the Interior may deem advisable.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 735.]

Feature costs of Strawberry Valley project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys:		
Surveys, topographic	$9,601.19	
Surveys, reconnoissance	5,261.52	
Stream gauging	13,632.81	
Irrigation investigations	12,038.66	
Power survey, sixth water	1,520.96	
Experimental investigations	43.99	
		$42,099.13
Storage system:		
Preliminary and general	71,085.65	
Dam	335,931.12	
Spillway	50,879.12	
Tunnels	1,248,198.77	
Flumes	6,823.38	
Feed canals	114,345.38	
Used equipment	24,159.43	
		1,851,422.85

Feature costs of Strawberry Valley project to June 30, 1916—Continued.

Features.	Subfeature.	Principal feature.
Canal system:		
Preliminary and general	61,843.11	
Diversion dam and headworks	52,391.42	
Tunnels	49,458.45	
Main canals	590,279.00	
Flumes (estimated cost over $500)	1,456.48	
Bridges (estimated cost over $500)	9,975.96	
Wasteways (estimated cost over $500)	25,818.10	
		791,222.52
Lateral system:		
Preliminary and general	24,707.97	
Headworks	2,767.13	
Laterals and sublaterals	307,393.40	
Flumes (estimated cost over $500)	3,669.57	
Siphons (estimated cost over $500)	1,525.18	
		340,063.25
Power system:		
Central station	55,531.71	
Transmission lines	2,424.12	
		57,955.83
Farm units, preliminary and general		4,208.63
Permanent improvements and land, real estate and permanent improvements		5,260.00
Telephone system, telephone lines		14,668.61
Operation and maintenance during construction:		
Operation	8,467.81	
Maintenance	18,703.85	
Cost of producing commercial power during construction	58,867.26	
		86,038.92
Gross cost of construction of project to June 30, 1916		3,192,949.74
Less revenues earned during construction period:		
Rental of buildings	5,922.80	
Rental of grazing of farming lands	62,005.25	
Rentals, power, and light	32,411.00	
Rentals of irrigation water	678.00	
Rentals of telephone and tolls	1,431.06	
Contractor's freight refunds	46.06	
Forfeitures by defaulting bidders and contractors	270.00	
Profit on mess-house operations	5,026.36	
Profit on mercantile store operations	9,235.29	
Profit on hospital operations	[1] 2,358.79	
		114,667.01
Net cost of construction of project to June 30, 1916		3,078,282.73

[1] Deduct.

Estimated cost of contemplated work, Strawberry Valley project, during fiscal year 1917.

Features.	Subfeatures.	Principal features.
Examination and surveys		$500.00
Storage works, spillway, Strawberry Dam		7,000.00
Canal system:		
Preliminary and general work	$900.00	
Flumes	5,062.50	
Headworks	2,000.00	
Main canals	12,037.50	
		20,000.00
Lateral system, laterals and sublaterals		200,000.00
Farm unit, preliminary and general work		2,000.00
Operation and maintenance, public notice:		
Development	11,487.50	
Carriage	10,313.40	
Drainage and flood protection	500.00	
Power system	12,199.10	
Miscellaneous	3,500.00	
		38,000.00
Messes		2,192.50
Hospital		307.50
Total		270,000.00

WASHINGTON, OKANOGAN PROJECT.

CALVIN CASTEEL, project manager, Okanogan, Wash.

LOCATION.

County: Okanogan.

Townships: 33 to 34 N., Rs. 25 to 27 E., Willamette meridian.

Railroad: Great Northern (branch line).

Railroad stations and estimated population, January 1, 1916, Okanogan, 1,000; Omak, 400; Riverside, 250.

WATER SUPPLY.

Source of water supply: Salmon Creek.

Area of drainage basin: 121 square miles above Conconully Dam.

Annual run-off in acre-feet of Salmon Creek at Jones's ranch, near Okanogan (140 square miles), 1903 to 1915: Maximum, 56,500; minimum, 17,350; mean, 29,118.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916: 10,099 acres.

Area under water-right applications, rental, and vested water-right contracts to June 30, 1916: 9,900 acres.

Length of irrigating season: May 1 to September 1—123 days.

Average elevation of irrigable area: 1,000 feet above sea level.

Rainfall on irrigable area: At Omak, Wash., six-year average, 12.28 inches; 1915, 15.98 inches. At Conconully, Wash., at base of Salmon River watershed, 16-year average, 16.5 inches; 1915, 15.98 inches.

Range of temperature on irrigable area: —10° to 105° F.

Character of soil of irrigable area: Volcanic ash and gravel on upper benches and sand and gravel on lowlands along Okanogan River.

Principal products: Fruit, hay, grain, and vegetables.

Principal market: States east.

LANDS OPENED FOR IRRIGATION.

Dates of public notices and orders: November 12, 1908; March 12, 1910; April 8, 1910; February 23, 1911; March 28, 1911; April 29, 1912; July 6, 1912; March 10, 1913; June 16, 1913; January 16 and September 24, 1914; March 20, May 15, and July 28, 1915; March 16, 1916.

Location of lands opened: Tps. 33 and 34 N., Rs. 26 and 27 E., Willamette meridian.

Present status of irrigable area opened: Entered subject to the reclamation act, 1,234 acres; opened to entry, none; private lands, 8,393 acres.

Limit of area of farm units: Public, 40 acres; private, 40 acres.

Duty of water: 2½ acre-feet per acre per annum at the farm.

Building charge per acre of irrigable land: $65. Owing to reconstruction of portions of project, new contracts have been executed with Okanogan Water Users' Association and with individual water-right applicants providing for a maximum building charge of not to exceed $110 per acre.

Annual rental charge: Effective for irrigation year 1915 and payable March 1, 1916, and March 1 of each year thereafter until further notice. The annual rental charge was assessed according to amount of water used for all lands where advantage was taken of stay of proceedings of April 29, 1912, based on minimum charge of $1.75 per acre, payable whether water was used or not, which would entitle land to delivery of 1, 1½, or 2 acre-feet per acre, depending upon classification of the soil, additional water being furnished at the rate of 50 cents per acre-foot. For lands where stay of proceedings was not accepted the operation and maintenance charge has been changed from $2.25 per acre to a rate based upon the amount of water used, $1.50 being the minimum charge for 1 acre-foot of water, whether delivered or not, and $1 for each additional acre-foot.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys begun in 1903.
Construction recommended by board of engineers, October 9, 1905.
Construction authorized by Secretary, December 2, 1905.
First irrigation by Reclamation Service, season of 1908.
Conconully Dam completed, August, 1910.
Water surface in Conconully Reservoir reached spillway crest for first time May 19, 1914.
Power and pumping system completed, 1916.
Project practically completed, October, 1910.

IRRIGATION PLAN.

The irrigation plan of the Okanogan project provides for the storage of water in Salmon Lake and in Conconully Reservoir, controlled by Conconully Dam on Salmon Creek, about 2 miles below Conconully, Wash.; the control of Salmon Lake Reservoir by a short inlet canal from Salmon Creek and concrete outlet works; the control of Conconully Reservoir by means of an outlet tunnel discharging into Salmon Creek below the storage dam; the diversion of water from Salmon Creek by a dam about 12 miles below the reservoir into a canal system watering lands in the valley of Okanogan River between Riverside and Okanogan, Wash.; and the construction and operation of a pumping plant to be used to supplement the gravity supply of the project by pumping from the Okanogan River to approximately 1,050 acres of land on the sandy portion of the project known as Robinson Flat, where the duty of water is less than on the heavier soils. The power for the pumping is generated by two power plants constructed at drops Nos. 1 and 2 on the upper main lateral and transmitted to the pumping station near the town of Omak by 5½ miles of transmission line. This pumping plant is to be operated only during years when the gravity supply of water will not be sufficient.

The following features of the project—consisting of the inlet canal and outlet works to Salmon Lake; Conconully hydraulic filled dam, spillway, and outlet works; the diversion weir and distribution system—are completed and have been in use during irrigation seasons since 1910.

SUMMARY OF GENERAL DATA FOR OKANOGAN PROJECT TO JUNE 30, 1916.

Areas:		
Irrigable acreage when project is complete		10,099
Private land, June 30, 1916		10,099
Acreage service could have supplied season of 1915		10,099
Estimated acreage service can supply July 1, 1917		10,099
Acreage actually irrigated, season of 1915		7,800
Acreage cropped under irrigation, season of 1915		4,814
Crops:		
Value of irrigated crops, season of 1915		$254,425.00
Value of irrigated crops per acre cropped		52.60
Finances:		
Estimated cost of completed project		$840,000.00
Total construction cost to June 30, 1916		$807,741.06
Per cent complete, June 30, 1916		100.00
Appropriation for fiscal year 1917, total		$58,000.00
Allotment for construction, fiscal year 1917		$34,000.00
Estimated per cent complete, June 30, 1917		100.00
Appropriation, fiscal year 1916	$51,000.00	
Increase under 10 per cent provision of act	5,100.00	
Total appropriation		56,100.00

Finances—Continued.

Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$39,653.93		
Transfers	4,498.17		
		$44,152.10	
Registered liabilities chargeable to 1916 appropriation		7,721.48	
			$51,873.58
Unencumbered balance, July 1, 1916			4,226.42

Repayments:

Construction charges—	
Accrued to June 30, 1916	76,231.66
Collected to June 30, 1916	24,622.55
Uncollected June 30, 1916	51,609.11
Operation and maintenance charges (public notice)—	
Accrued to June 30, 1916	36,300.89
Collected to June 30, 1916	36,242.39
Uncollected June 30, 1916	58.50
Water-rental charges—	
Accrued to June 30, 1916	89,492.83
Collected to June 30, 1916	72,212.22
Uncollected June 30, 1916	17,280.61

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

SALMON LAKE RESERVOIR.

Salmon Lake is a narrow body of water 3½ miles long located on a tributary of the North Fork of Salmon Creek. It is utilized to store water between elevations 2,285 and 2,295 feet above sea level. The inlet canal was constructed in 1906 and the outlet structure in 1907; the channel below the outlet was deepened and widened and in part rirapped in 1909.

In the spring of 1912 a board of engineers visited Salmon Lake Reservoir, which at that time had a storage capacity of about 2,000 acre-feet, and recommended that the capacity be increased to about 3,000 acre-feet by cutting down the outlet channel, raising the outlet structure, and the construction of a low embankment across the lower end of the lake. This report was approved by the director on June 28, 1912, and in the fall of that year the work was begun, being continued the following year. Up to the close of the fiscal year 1916 the outlet had been lowered 3 feet for a distance of 1,350 feet, a wooden flume 24 by 48 inches constructed in the new channel up to the outlet gate, and a new concrete outlet structure with iron gate installed, requiring the placing of 23 yards of reinforced concrete. The embankment recommended by the board was not constructed on account of opposition of the property owners adjacent to the proposed structure, who claimed that the raising of the water surface in the lake would damage their property by seepage; however, the estimates for the fiscal year 1917 make provision for this work, as the town has become largely depopulated on account of removal of the county seat to Okanogan and it is not anticipated that serious opposition will materialize.

CONCONULLY DAM.

Conconully Reservoir is formed by an earth dam 1,000 feet long and 64 feet high built across Salmon Creek a short distance below the confluence of its north and west forks and 2 miles from Conconully, Wash. The dam was constructed by the hydraulic-fill method.

Construction work was begun on the dam in April, 1907, but on opening the cut-off trenches it was found that the material below the surface was unsuitable for a foundation; and on the recommendation of a board of engineers, who examined the work in May, 1907, a new site for the dam was selected 3,300 feet farther upstream. The change in site also involved extensive changes in the plans for the outlet works and spillway.

Work was begun at the new site in July, 1907, and during the season the dam site was cleared and grubbed; drainage and cut-off trenches were excavated; the outlet tunnel and gate shaft were driven; the excavation of the spillway was begun; sheet piling was driven by the aid of a water jet; crib dams were built on the south and west forks of Salmon Creek; and work was begun on over 3 miles of water-supply flume to two borrow pits one-quarter mile south of the dam site; and nearly three-fourths of a mile of steel-lined sluicing flume, supported on trestles with bents from 30 to 96 feet high, was constructed to the dam site and along its entire length. During the winter of 1907–8 parts of the tunnel were lined with concrete, excavation of the spillway was continued, and the first-stage flumes for water supply and for sluicing material into the dam were completed.

Sluicing operations were begun in April, 1908, and during the season, with an available water supply averaging 15¼ second-feet, about 100,000 cubic yards of material were sluiced into place. Sluicing was suspended on October 15, 1908.

In 1909 about 177,000 cubic yards of material were placed in the embankment.

In 1910 about 49,000 cubic yards of material were placed in the dam, which was completed on June 30, except for cleaning up, dressing the slopes, and dismantling the trestles.

The excavation of the spillway and spillway channel, involving the removal of 26,000 cubic yards of limestone, soapstone, and decomposed granite, was completed in July, and the placing of concrete in these structures was completed in September, 1908. The gate shaft was lined with concrete, and concrete lining in the tunnel was completed in October, 1908. In the spring of 1909 a temporary wooden gate was installed in the gate chamber for the purpose of controlling a small amount of water stored in the reservoir for irrigation during the season. In the fall of 1909 the permanent cast-iron gates with operating rods and floor stands were installed, and in the spring of 1910 a reinforced concrete gate house with a corrugated galvanized-iron roof was erected over the gate shaft.

At the close of the fiscal year 1910, Conconully Dam had been completed, with the exception of dismantling the sluicing trestles and dressing the slopes of the dam, which was all finished by August 1, 1910.

On June 10, 1912, a board of engineers submitted a report relating to the storage reservoirs of the project. Conconully Dam and appurtenant structures were inspected and found to be in a satisfactory condition. Seepage water existed along the toe of the dam and along the foot of the spillway ridge. It was recognized that this seepage would undoubtedly increase as the reservoir was filled, but this was not considered to be a serious matter unless the leakage should become much greater, in which event the board proposed methods for stopping the leakage by grouting on spillway crest, constructing a deep cut-off, or hydraulicking in front of the slopes of the ridge. It was recommended that the sum of $15,000 be included in the estimates of the ultimate building cost of the project for work on Conconully spillway and that allotment of this amount should be made whenever the need arose, but up to the close of the fiscal year 1916 this had not come to pass.

CANAL SYSTEM.

The grading for the Main Canal and Main High Line and Low Line Canals was done under nine informal contracts; the work was begun in September, 1906, and finished November 13, 1907, about 240,000 cubic yards of material being excavated. The structures were built and the concrete lining was placed by Government forces. The diversion dam was built in the fall of 1906 and the other concrete structures and concrete canal lining between June and November, 1907. The distributing laterals and sublaterals, involving the excavation of about 90,000 cubic yards of material, were built under twelve informal contracts during the summer and fall of 1907 and the early spring of 1908.

Wooden measuring devices, consisting of rating flumes and Cippoletti weirs with galvanized iron edges, were constructed at the entrances to all turnouts from all canals and laterals.

EXTENSION OF DISTRIBUTION SYSTEM.

As originally constructed the distribution system comprised about 40 miles of main canals, laterals, and sublaterals and did not provide for a direct delivery of water to each farm, except in those cases where the land was traversed by the canals. In order to obtain water it was necessary for those water users who were not situated adjacent to the canals to construct their own farm ditches and irrigation structures. This proved to be unsatisfactory, and in October, 1911, the officers of the water users' association requested the director, who was then on the project, to authorize the extension of the distribution system to provide for the delivery and measurement of the water by the United States on each farm. This the director promised to do if the water users by majority vote expressed such a desire and would agree to transfer to the Government such ditches and irrigation structures as they had constructed and such as would be required in extending the system. A large majority of the waters users voted in favor of the extension and operation of the system by the Government. On October 8, 1912, the plan received departmental approval. Funds for the prosecution of the work were allotted from time to time as required, in accordance with the report of the board of engineers, dated June 9, 1912, and actual construction work was commenced as early in 1913 as weather conditions would permit. Up to the end of the fiscal year 1916, in addition to the ditches and irrigation structures transferred to the United States by individual water users, there had been completed the following items of work:

15 miles of small earth ditches of 10 second-feet capacity and smaller, involving 18,290 cubic yards of excavation.
24 miles of iron pipe lines, ranging from 4 to 14 inches in diameter and from 22 to 18 gage in thickness.
1,330 linear feet of No. 36 and No. 48 steel flume.
1,000 minor wooden structures, consisting of headgates, weirs, pipe inlets and outlets, etc.

SEEPAGE LOSSES.

As originally constructed the canals and laterals were all open earth ditches with the exception of about 3,000 linear feet, where the location was along steep side-hills and where monolithic concrete lining was placed in order to make the canals safe for operation. The operation of the system during 1910 and 1911 made it evident that the canals would have to be improved before a sufficient quantity of water could be delivered to the lands after all or a large percentage of the project had been brought under cultivation. The reason for this was that, with the seepage losses which had been encountered, the canal system was not large enough to carry sufficient water for the irrigation of the lands; moreover, the water supply available from Salmon Creek was not sufficient for that purpose. During 1911, with only 65 per cent of the lands under cultivation, the available water supply in the reservoirs was exhausted on August 1, the quantity of water delivered to the land amounting to only 1.18 acre-feet per acre. This shortage was due almost wholly to seepage from the canals in transportation, which amounted to more than 51 per cent.

On February 24, 1912, a report was submitted by a board of engineers consisting of Chief Engineer A. P. Davis, Consulting Engineer D. C. Henny, and Supervising Engineer Charles H. Swigart, who recommended the immediate allotment of $20,000 for the purpose of lining with concrete those portions of the distribution system where seepage losses had been the greatest. This recommendation was approved, funds were allotted, and actual work was commenced as early as weather conditions would permit.

INCREASED COST APPROVED.

The board estimated that approximately $250,000, or $30 per acre, would be required for the work proposed to be done, in order to make the project a success and provide an ample water supply. The building charge had been originally announced by public notice as $65 per acre, but this amount had already been expended in the construction of the project and it was, therefore, necessary to arrange some method by which the cost of the additional work contemplated could be returned to the reclamation fund. On April 1, 1912, at the annual meeting of the stockholders of the Okanogan Water Users' Association, a proposition was submitted that, if the water users would agree to repay the additional cost, the Reclamation Service would proceed with this work. This the members of the association, by an almost unanimous vote, agreed to do. Accordingly, the stay of proceedings in order of April 29, 1912, was issued postponing further payments on the construction charge at the $65 rate, substituting in lieu thereof a temporary rental charge of $3 per acre and providing for an ultimate water-right charge of $100 or more per acre as to all lands the owners of which filed in writing their acceptance of the terms and conditions of the order. By order dated July 6, 1912, the amount of this final building cost was limited to $110 per acre. Practically all of the water-right applicants accepted this increased cost and executed contracts agreeing to make water-right applications providing for payment of this charge when announcement should be made by the Secretary of the Interior. A new contract was also made with the water users' association under date of May 11, 1912.

Supplementing the meeting and report of the board of engineers on February 24, 1912, the same board convened on the project on June 9 and recommended the following program of work for safeguarding and supplementing the project water supply:

Concrete lining of canals	$150,000
Power and pumping development	82,000
Extension of distribution system	52,000
Improvements to storage works	20,000
Total	304,000

This recommendation was approved and immediate steps taken to carry it out.

CANAL LINING.

As an experiment a small quantity of plaster concrete lining was placed on the upper main lateral in 1910 and 1911. This lining consisted of a layer of concrete 1½ inches thick plastered on a specially prepared gravel foundation following the natural slope of the canal banks. As this proved to be a success, the lining placed in the spring of 1912 was done in the same manner. The work was continued in the fall of 1912 after the close of the irrigation season, and similar work was done each spring and fall up to the close of the fiscal year 1916, the work of necessity being done outside of the irrigation season, commencing as soon in the spring as weather conditions would permit and continuing in the fall until winter set in. For this purpose a small concrete mixer of one-quarter yard capacity, mounted on trucks and operated by a 5-horsepower gasoline engine, was purchased in August, 1912, and was used each season on this work up to June 30, 1916. Up to this time approximately 30 miles of canals had been lined, requiring 8,280 cubic yards of concrete.

POGUE DRAINAGE DITCH.

Certain lands adjacent to drop No. 1, where the lower main lateral leaves the high-line canal, had become swamped by seepage. A ditch about 2,300 feet in length, and involving the removal of 3,250 cubic yards of earth, was excavated in April, 1912, to drain this water off into a natural wasteway running into the Okanogan River.

TELEPHONE SYSTEM.

In 1906 a grounded telephone line about 19 miles in length was constructed connecting Conconully Dam and project headquarters.

By 1912 it had become necessary to reconstruct this line on account of the rotting of the poles. This was accordingly done; a new pole line was set and the line straightened and made a metallic circuit by the addition of another wire. The line was also extended along the canals of the distribution system for use in operation work. The reconstructed line is 35 miles in length and included the installation of 21 telephone instruments.

POWER AND PUMPING SYSTEM.

The report of the board of engineers dated June 9, 1912, contemplated the construction of a hydroelectric pumping plant for the irrigation of 1,050 acres of land on the portion of the project known as Robinson Flat by pumping from the Okanogan River with electrical energy developed at the drops in the project canals. This plant was to be part of the plan for improving the project water supply, and was to be used only during such years as the gravity flow of Salmon Creek was insufficient for the proper irrigation of the lands. Construction work on this system was begun early in July, 1914, and had been completed by June 30, 1915, with the exception of the erection of a surge pipe and tower 70 feet high in connection with the steel part of the discharge pipe and the final testing of the plants. The system consists of power plants at drops Nos. 1 and 2 of the canal system, connected with the pumping plant on the Okanogan River near the town of Omak by 5½ miles of transmission line. From the pumping plant the water is discharged into the canals of the gravity system by means of 250 feet of 30-inch riveted steel pipe and 4,417 linear feet of continuous wood-stave pipe. Each of the power plants has a rated capacity of 250 horsepower. The pumping plant contains two units, comprising two 2-stage centrifugal pumps of 6 second-feet capacity each, and each operated by a 200-horsepower variable-speed motor. The three buildings are of reinforced concrete construction, with corrugated iron roofing, which, with the transmission line, were built by Government forces. The electrical apparatus was furnished under formal contracts with the Allis-Chalmers Manufacturing Co. and the General Electric Co. The hydraulic apparatus was furnished by Charles C. Moore & Co. and the Pelton Water Wheel Co. The wood-stave pipe line was erected under contract with the American Wood Pipe Co., of Tacoma, and contract was let to W. A. Kraner & Co., of Portland, for erection of the steel pipe lines at the three plants.

COLVILLE EXTENSION.

Early in the history of the project an agitation was started for the investigation of the feasibility of irrigating a narrow strip of land lying along the Okanogan River in the Colville Indian Reservation, opposite the main body of the project. This agitation was the result of the passage of the act of Congress approved March 22, 1906, authorizing the sale and disposition of surplus or unallotted lands of the reservation. A preliminary survey was made late in 1906, which developed that approximately 5,000 acres of land lying along the river directly opposite the project could be irrigated by pumping, with a maximum lift of 100 feet, power to be developed in Salmon

Creek Canyon below Conconully Dam. On account of the relatively high construction cost of such a project, however, as shown by the estimates then prepared, it was not considered advisable to allot any money for this purpose at that time. As all of the lands to be irrigated lie in the Indian reservation, it was proposed to construct the irrigation works in cooperation with the Indian Service, which would provide the funds, the Reclamation Service to do the work. In view of the probable ultimate construction of this extension, withdrawal was made of the irrigable lands within its proposed boundaries.

In 1911 the proposed extension was again taken up and expenditure of funds authorized on June 5, 1911, to cover the cost of the final surveys. This work was prosecuted throughout the summer and fall. The area to be included within the extension was reduced to 3,600 acres. The work done included surveys for power-house site on Salmon Creek, in Ruby Canyon. Based on these surveys, final estimates were prepared and submitted to the Indian Office for approval. On June 9, 1912, a board of engineers, consisting of A. P. Davis, D. C. Henny, and Charles H. Swigart, considered plans for this extension and recommended that the work be done, at an estimated cost of $330,000, or about $91 per acre, but the scheme of joint construction by the Reclamation Service and the Office of Indian Affairs was finally abandoned on account of the high cost and the fact that no funds were then available for that purpose. The lands withdrawn were ultimately restored and allotted to the Indians.

CONSTRUCTION DURING FISCAL YEAR.

Canal lining.—The work of placing concrete lining in the canals and laterals of the distribution system to stop seepage losses was continued after the irrigation season of 1915 until stopped by winter weather and during the spring of 1916 prior to the beginning of the irirgation season. During this period a plaster lining 1½ inches thick, following the plan used in previous years, was placed in 42,957 linear feet of canals, requiring 2,021 cubic yards of concrete.

Extension of distribution system.—During the year this work was continued for the delivery of water to individual farms as new tracts were brought under irrigation. There was excavated 2,550 linear feet of small ditches with capacity less than 10 second-feet, involving the moving of 524 cubic yards of earth. There were laid 3,344 linear feet of black iron pipe ranging in size from 5 to 10 inches and 20 to 22 gauge in thickness, and 27 minor wooden structures, consisting of outlets, measuring devices, drains, etc., were installed. The iron pipe was manufactured on the project under informal contract with a local firm from iron sheets purchased at the rolling mills and supplied to the contractor by the United States. The completed pipe was dipped in two coats of asphaltum at the dipping plant maintained at the town of Omak for that purpose. During the month of June, 1916, 21,760 linear feet of this pipe, ranging from 4 to 12 inches in diameter, were manufactured at Omak and dipped in asphalt. The dipping plant was then dismantled, as all pipe required for the completion of this work had been made.

Power and pumping plants.—During the spring of 1916 the 30-inch wood stave pipe line, which is 4,417 feet in length, was painted with coal tar, and a surge pipe, consisting of cast-iron stand pipe 70 feet high supported by steel tower, was erected on the brow of the hill at the junction of the steel and wood stave pipe lines. The first test of the power and pumping plants made at the close of the fiscal year 1915 developed certain minor deficiencies in the machinery. The contractors supplied new parts to remedy these defects, which were placed, and the plants were ready for final testing at the close of the fiscal year 1916.

OPERATION AND MAINTENANCE.

The run-off of Salmon River during 1915 amounted to 35,234 acre-feet, which was only about 500 acre-feet less than the run-off during the preceding year and about 30 per cent greater than the average annual run-off for the 13 years since records of the flow of this stream have been kept. This run-off was greater than the capacity of the reservoirs of the project, and 8,375 acre-feet ran to waste into the Okanogan River and through the various wasteways in the project distribution system. At the end of the irrigation season approximately 4,700 acre-feet remained in storage, which was about 700 acree-feet in excess of the quantity remaining at the close of the season of 1914.

The irrigation season of 1915 began on April 27, when water deliveries were begun, owing to hot, dry weather throughout the month of April, and continued until September 5, extending over a period of 142 days. On account of unusually dry weather in the fall it was also necessary to run a small head of water for irrigation the latter part of October and the fore part of November, in order that the orchards in certain portions of the project which had become very dry might be wet up before the ground was frozen for the winter. The service was prepared to deliver water during the year to 10,099 acres, of which 7,800 acres, or about 77.2 per cent of the total irrigable area, were actually irrigated. Water was delivered during the season to 440 farms, containing an aggregate of 9,400 acres of irrigable land.

The growing season, with the exception of the month of May, was one of the hottest and driest that the project has experienced. The hot weather began early in April and, with the exception of a portion of the month of May, continued almost without interruption well along into September. The principal drawback to farming operations, however, was due to grasshoppers, which appeared on the project in large numbers early in July and caused considerable damage to fruit trees and gardens. Alfalfa was also attacked and in many cases the third cutting was almost a total loss. Grasshoppers were also very numerous throughout the project early in the season of 1916, having hatched from eggs deposited the previous year. At the close of the fiscal year, however, they had not attained sufficient size to do any great amount of damage, except in a few isolated places.

Classification of lands.—The use of irrigation water during the season of 1915 was not as extensive as in 1914 on account of difference in method of assessing charges to repay the cost of operating the project. Up until 1915 this cost had been met by a flat rental charge of $3 per acre, but, effective with the season of 1915, an order of the department was issued basing these charges upon the amount of water used. The lands of the project were divided into three classes according to the quality of the soil, the better lands being designated as class A, the lands next in quality, class B, and the poorer or sandier lands, class C. The public notice provided for a minimum charge of $1.75 per acre, whether water was used or not, which would entitle class A lands to a delivery of 1 acre-foot per acre, class B lands to 1½ acre-feet per acre, and class C lands to 2 acre-feet per acre. Additional water was delivered for a charge of 50 cents per acre-foot, irrespective of the classification under which the land might fall. This scheme of charges provided ample revenue for the operation of the project and at the same time caused an actual decrease in the amount of water delivered to the irrigators. This public notice was continued in effect without change for the irrigation season of 1916.

Operation of system.—The entire distribution system was operated throughout the season without interruption, except for one day, on July 5, when a small cloudburst filled the main canal near the intake with gravel and other débris washed down from the hills. It was necessary to turn the water out for one day while this was being cleaned out. The system operated included 26 miles of concrete-lined canals, 24 miles of iron pipe lines, and about 26 miles of open-earth ditches, together with attendant structures of drops, checks, take outs, measuring devices, drains, etc. The quantity of water diverted for irrigation by the various canals and private ditches comprising the distribution system was 24,640 acre-feet, of which 18,580 acre-feet were delivered to the land, or 2.38 acre-feet per acre irrigated. The seepage and evaporation losses in the distribution system amounted to 20.2 per cent of the water diverted, being a saving of 6.2 per cent over the losses in 1914. This decrease was practically all due to concrete lining placed in the canals during the previous fiscal year, and the work done in 1916 will still further reduce these losses. Of the land irrigated, 6,457 acres under the project canals received 15,861 acre-feet of water, or 2.46 acre-feet per acre. The remainder of the land irrigated, or 1,343 acres, is situated under various private ditches diverting from Salmon River but incorporated as a part of the project, and received 2,719 acre-feet, or 2.03 acre-feet per acre. At the end of the calendar year 1915 the reservoirs of the project contained 6,100 acre-feet available for use.

The total operation and maintenance cost for the irrigation year ending November 30, 1915, was $11,455.31, which was equivalent to $1.13 per acre based on the total irrigable area of the project, or $1.47 per acre irrigated. The operation and maintenance estimate for the fiscal year 1916 was $15,000, or $1.87 per acre.

The rotation system of water delivery, which had been used successfully during previous years, was continued. The rotation period remained at seven days; that is, water was delivered to each water user as ordered for seven days and then shut off for seven days, the project being divided into two districts and water delivered to the lands in each alternately. Each water user was notified at the beginning of the season of the dates on which water would be available for his land, and this schedule was adhered to as strictly as conditions would permit, no one being delivered water out of period unless for some reason beyond his control he was prevented from irrigating during his period, or could give some other good and valid reason.

The operation of the system during the season was attended by no washouts or other accidents making necessary shutting off the water, with the exception of the cloud-burst on July 5. During the rainy period in May the orders for water practically stopped. Water deliveries were handled by an operating force of five patrolmen, who visited each day every structure through which water was being delivered and made a record of the amount of water flowing to each irrigator. The regular maintenance crew consisted of two teamsters with teams, who acted as subforemen, with two men each.

Season of 1916.—The winter of 1915–16 was one of the most severe in the history of the project. The first snowfall occurred on November 10 and by the end of the month the snowfall had amounted to 20.5 inches. On April 1 snow was still lying in drifts and sheltered spots on the project lands and at Conconully Dam the depth amounted to 10 inches. The total snowfall for the winter amounted to 55 inches. During January and the fore part of February unusually high, cold winds from the north prevailed, blocking all roads with drifts, making travel very difficult and at times impossible. The mean temperature for the month of January at the Weather Bureau station at Omak was 11° above zero. The unusual snowfall assured a heavy run-off throughout the succeeding season; fortunately, however, a very cool, backward spring retarded the melting of the snows, which were still visible at the end of the fiscal year on the higher mountains forming the watershed of Salmon River. Toward the end of April, when the spring run-off had begun and the reservoirs were filling up, it was deemed expedient to release water from storage and allow it to run to waste into the Okanogan River, to be better able to control the high water when the run-off reached its height. Accordingly, the outlet gates at Conconully Reservoir were raised on April 29 and from that date until the end of the year water was wasted continuously into the Okanogan River, the total quantity being approximately 17,300 acre-feet, or considerably in excess of the total storage capacity of the project. The maximum flood occurred on June 26, when about 400 second-feet were passing over the measuring weir below the reservoir. Some damage was done to roads and bridges along the lower Salmon Creek Valley which had not been constructed to withstand such high water.

The irrigation season of 1916 began on May 5, when water was turned into the project canals and water deliveries commenced. The trustees of the Okanogan Water Users' Association, in view of the apparent heavy run-off, had petitioned that, during the period when water was being wasted from the reservoir, deliveries be made to the project lands at two-thirds of the regular price; that is, that 3 feet of water be delivered for the price of 2. This request was approved and deliveries were made on this basis throughout the remainder of the fiscal year, as water was still being wasted at that time. During the first two months of the irrigation season water was delivered to an area of approximately 8,000 acres.

At the end of the fiscal year the irrigation system and structures were in the best condition in the history of the project. About 30 miles of canals had been lined with concrete up to this time and 25 miles of iron pipe lines laid. Nearly all of the important structures and main canal turnouts, which were originally constructed of wood, had been replaced with concrete and steel, and all of these improvements had a marked effect on the amount of maintenance work necessary to keep the system in good operating condition.

Maintenance work during the spring, preparatory to the beginning of the irrigation season, was unusually heavy, due to alternate freezing and thawing while the snow was going off and to the run-off from the melting snows, which caused the sloughing of the canal banks and the washing of considerable débris into them. It was also necessary to remove a large amount of sand and silt deposited during the irrigation season of 1915. At the close of the fiscal year the prospects were bright for a very successful season. The heavy snows of the winter, together with rains at the close of the year, made it certain that the run-off for the year would be very close to the maximum for the 13 years that records of the stream flow have been kept and that the quantity of water remaining in the reservoirs at the close of the irrigation season would be the largest in the history of the project. The crop estimate indicated that the returns for the year would be very encouraging to the farmers, with prospects for prices of all classes of produce considerably in excess of those for the preceding year, which, however, were very good.

Historical review, Okanogan project.

Item.	1911	1912	1913	1914	1915	1916[1]
Acreage for which service was prepared to supply water.	10.051	10,051	10,084	10,099	10,099	10,099
Acreage irrigated	6,467	7,263	7,700	7,740	7,800	8,000
Miles of canal operated	41	46	47	74	77	77
Water diverted (acre-feet)	17,490	18,740	20,300	29,700	24,640	25,000
Water delivered to land (acre-feet)	8,259	9,040	11,993	20,085	18,580	20,000
Per acre of land irrigated (acre-feet)	1.27	1.24	1.57	2.59	2.38	2.50

[1] Estimated.

SETTLEMENT.

Although there was not much money in circulation among the farmers, the bank statements showed a fairly prosperous condition of affairs and economic conditions on the project may safely be said to be still improving. There was no increase in population of the farms, but among the project towns a healthy growth was manifested. The town of Okanogan especially, which became the county seat of Okanogan County on January 1, 1915, experienced a considerable boom on this account, and a number of new residences and business houses, including a fine concrete and tile courthouse costing about $25,000, were erected. The land movement during the year amounted to practically nothing, and prices, if there can be said to have been any change, suffered a still further decline. In many instances well-improved young orchards just arriving at the bearing stage can now be purchased for the price of the raw land six or seven years ago, and it is believed that these prices are now getting down to a basis of actual value.

While there was no increase in the selling price of land, the gross land value as shown by the farm summary, compiled at the close of the calendar year 1915, shows an increase over the previous year of $107,000, or $11.40 per acre. The total gross investment in land and stock and equipment for the year showed an increase of $415,000, or

$44.10 per acre. The live-stock increase amounted to $35,000 in value, or nearly 33 per cent over the previous year. This increase was made up as follows: Horses increased 6 per cent in number and 30 per cent in value; cattle increased 50 per cent in number and value; hogs increased 24 per cent in number, with an appreciable increase in value.

The raw land of the project is slowly but steadily being brought under cultivation, and at the end of the year only about 22 per cent of the total project area remained uncultivated. Practically all of this improvement was due to the enforced cultivation clause of the reclamation extension act, but a portion of it, of course, followed the natural growth and development caused by the success of the project as a whole as a fruit-growing proposition.

Practically all of the fruit growers are members of the Northwest Fruit Growers' League or some other selling organization for the marketing of the fruit crop of the project. These organizations have affiliated with the Fruit Growers' Agency (Inc.), formed under the auspices of the Office of Markets and Rural Organization of the Department of Agriculture for the purpose of consolidating all of the selling agencies in the Northwestern States to the mutual advantage of the individual growers. During the winter and spring months these organizations were perfected and completely organized for the handling of the 1916 crop. General headquarters were established at Spokane and a close relation with the smaller organizations was maintained. Constant advice and information as to methods of marketing, packing, and warehousing, as well as market reports and prices, were issued from time to time. At the close of the year the local organizations at Okanogan and Omak were constructing permanent centralized shipping warehouses and packing plants of wood and concrete of sufficient size to handle the crop of the project for several years to come.

Settlement data, Okanogan project.

Item.	1913	1914	1915	1916
Total number of farms on project	525	550	560	560
Population	1,200	921	900	950
Number of irrigated farms	441	448	440	450
Operated by owners or managers	439	448	434	440
Operated by tenants	2	2	6	10
Population	1,200	921	900	960
Number of towns	3	3	3	3
Population	1,200	1,350	1,500	1,650
Total population in towns and on farms	2,400	2,271	2,400	2,600
Number of public schools	7	7	7	7
Number of churches	6	7	8	8
Number of banks	4	4	4	4
Total capital stock	$135,000	$135,000	$135,000	$135,000
Total amount of deposits	$250,000	$272,000	$325,000	$400,000
Total number of depositors	1,485	1,580	1,650	1,700

PRINCIPAL CROPS.

The area cropped on the project during 1915 was 4,814 acres, an increase of more than 51 per cent over the preceding year, due to the added area of young orchards which arrived at a bearing stage. The total value of the crops raised was $254,425, or $52.60 per acre cropped, an increase in value of 143 per cent over the crop census for 1914. The principal increase was in apples, which produced from

$26.70 to $50.20 per acre; the total value was approximately five times that of the preceding year and the yield practically four times as great.

During the year 300 cars of apples and about 10 cars of small fruits, consisting principally of apricots and peaches, were shipped from the project. Considerable care was exercised by the growers in grading, packing, and shipping, and a rigid system of inspection was maintained by the league, so that a high grade and pack of fruit should be turned out, thus insuring the stability of the brand under which the fruit was shipped and creating a permanent market. The net returns to the grower on apples varied from 50 cents to $1.50 per box, depending upon variety and grade.

Some trouble was experienced early in the season with fire blight, which made its appearance on the project, but a thorough and systematic system of inspection, with the pruning out of all diseased wood, practically stopped the spread of the infection before the close of the season. The growers were very diligent in the matter of spraying and eradication of codling moth, aphis, and other pests, and consequently a high grade of fruit was produced. The growers were encouraged by their organizations and also by the State horticultural inspectors, who have representatives on the project, to continue this work during the season of 1916. This was done, and the indications are that the grade of fruit will be at least as high as that produced during 1915.

Crop report, Okanogon project, Washington, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa hay	1,327	Tons	3,725	2.8	$9.00	$33,525	$25.20
Apples	3,628	Pounds	7,287,000	2,000	.025	182,175	50.20
Beans	31	Bushels	180	6	3.60	648	20.90
Clover hay	62	Tons	130	2	10.00	1,300	21.00
Corn, Indian	81	Bushels	2,260	28	.60	1,356	16.70
Corn, fodder	94	Tons	268	1½	7.50	2,010	13.20
Fruits, small	5	Pounds	15,800	3,160	.03	474	94.80
Garden	152					8,175	87.00
Hay, except above	157	Tons	225	1.5	10.00	2,250	14.30
Onions	.75	Bushels	150	200	.90	135	180.00
Pasture	400				10.00	4,000	10.00
Peaches	132	Pounds	647,000	4,900	.01	6,470	49.00
Pears	33.5	...do	98,800	2,960	.025	2,470	70.70
Prunes	7	...do	33,200	4,760	.01	332	47.40
Potatoes, common	62.25	Bushels	7,110	110	.90	6,399	102.80
Apricots	34	Pounds	145,200	4,270	.01	1,452	42.70
Carrots	7	Tons	98	14	8.00	784	112.00
Wheat	10	Bushels	200	20	.75	150	15.00
Miscellaneous	3					320	106.60
Less duplicated areas	1,412.5						
Total cropped acreage	4,814	Total and average				264,425	52.60

Crop.	Area (acres).
Irrigated; no crop:	
Nonbearing orchards	2,231
Young alfalfa	302
Ground fall plowed	26
Miscellaneous	607
Less duplicated areas	180
Total irrigated acreage	7,800

Areas.	Acres.	Farms.	Per cent of project.
Farms reported	9,400	440	93.8
Irrigated area, total	7,800	440	77.2
Irrigated under water-right applications	6,233	380	61.7
Irrigated under rental contracts	186	20	1.8
Irrigated under vested water rights	1,381	40	13.6
Cropped area	4,814	440	47.6

PUBLIC NOTICES AND ORDERS.

ORDER, JULY 28, 1915.

Whereas all landholders under the Okanogan project, Washington, who duly accepted the stay of proceedings and the conditions thereof as set forth in the order issued April 29, 1912, have been subject to the payment of a water rental charge of $3 per acre, of irrigable land per annum; and

Whereas section 11 of the reclamation extension act of August 13, 1914 (38 Stat., 686), provides for water service in advance of the fixing of the construction charge and that the charges for such service shall be subject to the same penalties and to the provisions for cancellation and collection as therein provided for other operation and maintenance charges: Now, therefore,

It it hereby ordered, That the water service or rental charge against lands entitled to the stay of proceedings provided for in the order of April 29, 1912, for the Okanogan project beginning with the irrigation season of 1915 and continuing thereafter until further notice, shall be as follows, viz:

1. The lands of the project shall, for the purpose of fixing the rental charges, be divided into three classes, viz:

Class A, lands with a light volcanic ash soil requiring the minimum amount of water for irrigation.

Class B, lands requiring a larger amount of water than class A, but not so much as class C.

Class C, lands having the coarsest and most porous soils and requiring the maximum amount of water.

2. A minimum charge of $1.75 per irrigable acre per annum is hereby fixed for each irrigable acre in classes A, B, and C, which will entitled the water user of class A lands to 1 acre-foot per acre per annum; class B lands to 1½ acre-feet per acre per annum; and class C lands to 2 acre-feet per acre per annum. Additional quantities of water for lands in classes A, B, and C will be furnished at the rate of 50 cents per acre-foot.

3. The classification of the lands is shown on a map duly filed in the records in the project office.

4. All of said lands shall be subject to the provisions for discounts and penalties, cancellation and collection, as provided in the reclamation extension act for other operation and maintenance charges.

A. A. JONES,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 787.]

Feature costs of Okanogan project to June 30, 1916.

Features.	Sub-feature.	Principal feature.
Examination and surveys		$4,603.27
Storage works:		
Salmon Lake Reservoir—		
Inlet canal	$1,999.00	
Outlet works	6,578.52	
Conconully Reservoir—		
Real estate	37,788.60	
Clearing reservoir site	8,913.05	
Conconully Dam	221,830.99	
Spillway	37,770.79	
Outlet works	24,499.19	
		339,380.14
Pumping for irrigation:		
Power plant No. 1	11,677.85	
Power plant No. 2	13,597.59	
Pumping plant	29,690.54	
		54,965.98
Lateral system:		
Diversion weir	4,152.89	
Main canal, main laterals, and sublaterals	382,244.27	
		386,397.16
Power system, transmission line		5,435.21
Farm units		1,889.92
Permanent improvements and land:		
Roads	1,105.98	
Buildings	7,265.30	
		8,371.28
Telephone system		6,698.10
Operation and maintenance during construction		4,736.36
Plant accounts		1,869.91
Gross cost of construction of project to June 30, 1916		814,347.33
Less revenues earned during construction period:		
Rental of buildings	224.00	
Rental of grazing and farming lands	540.00	
Rental of irrigation water	1,670.50	
Profit on hospital operations	332.78	
Loss on messhouse operations	[1] 193.83	
		2,573.45
Net cost of construction of project to June 30, 1916		811,773.88

[1] Deduct.

Estimated cost of contemplated work, Okanogan project, during fiscal year 1917.

Features.	Sub-feature.	Principal feature.
Storage works:		
Salmon Lake improvements	$3,550.00	
Conconully drainage and land purchase	10,000.00	
		$13,550.00
Pumping for irrigation:		
Power plant No. 1	500.00	
Power plant No. 2	500.00	
Pumping plant	500.00	
		1,500.00
Lateral system, laterals and sublaterals		20,750.00
Operation and maintenance under public notice		22,000.00
Hospital operations		200.00
Total		58,000.00

WASHINGTON, YAKIMA PROJECT.

R. K. TIFFANY, project manager, Sunnyside and Tieton units, North Yakima, Wash.; C. E. CROWNOVER, project manager, storage unit, Meadow Creek, Wash.

LOCATION.

Counties: Yakima, Benton, and Kittitas.

Townships: 8 to 22 N., Rs. 11 to 27 E., Willamette meridian.

Railroads: Northern Pacific; Chicago, Milwaukee & St. Paul; Oregon-Washington Railroad & Navigation Co.; Yakima Valley Transportation Co.

Railroad stations and estimated population January 1, 1916: Grandview, 700; Sunnyside, 1,430; Outlook, 150; Granger, 360; Zillah, 500; Mabton, 600; Donald, 50; Benton City, 50; Prosser, 1,500; Ellensburg, 5,000; Thorp, 300; Yakima, 200; North Yakima, 16,500; Naches, 500; Wapato, 500; Toppenish, 1,700; and Parker, 50.

WATER SUPPLY.

SUNNYSIDE UNIT.

Source of water supply: Yakima River and tributaries.

Area of drainage basin: 3,550 square miles.

Annual run-off in acre-feet of Yakima River at Union Gap: 3,550 square miles, 1897 to 1915, maximum, 4,370,000; minimum, 1,570,000; mean, 3,220,000.

TIETON UNIT.

Source of water supply: Tieton River and its tributaries.

Area of drainage basin: 247 square miles.

Annual run-off in acre-feet of Tieton River at canal headworks, 1908–1915, maximum, 484,000; minimum, 252,000; mean, 300,000.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which service is prepared to supply water, season of 1916: Sunnyside unit, 93,226 acres; Tieton unit, 33,520 acres.

Area under water-right applications and rental contracts, season of 1916: Sunnyside unit, 86,878 acres; Tieton unit, 28,890 acres.

Length of irrigating season: Sunnyside unit, April 1 to October 31, 214 days; Tieton unit, May 1 to October 1, 153 days.

Average elevation of irrigable area: 1,000 feet above sea level.

Rainfall on irrigable area: At Sunnyside, 1895 to 1915, average, 6.67 inches; 1915, 8.28 inches; at Tieton, 1915, 12.13 inches.

Range of temperature on irrigable area: —21° to 110° F.

Character of soil of irrigable area: Sunnyside unit—on about three-fourths of the unit the soil is sandy loam or volcanic ash from 10 to 60 feet deep. The remainder is decomposed basalt, underlain by gravel or a combination of this with the above-named soils. Tieton unit—volcanic ash.

Principal products: Forage, hops, vegetables, and fruit; stock and dairy products.

Principal markets: The cities of Washington, Oregon, and California; all Alaska trading points; fruit markets, including all eastern cities.

LANDS OPENED FOR IRRIGATION.

SUNNYSIDE UNIT.

Dates of public notices: November 18, 1908; March 2, 1909; April 18, April 19, May 2, 1910; March 15, 1911; February 29, May 31, 1912; June 16, June 23, October 2, 1913; March 10, April 11, and September 24, 1914; March 31, July 27, 1915; April 6, May 31, 1916.

Location of lands opened: Tps. 8 to 12 N., Rs. 19 to 27 E., Willamette meridian.

Present status of irrigable lands opened: 2,604 acres opened subject to reclamation act; 657 acres of State lands; 89,965 acres in private ownership.

Duty of water: 3 acre-feet per acre per annum at the farm.

Limit of area of farm units: Public, 80 acres; private, 160 acres.

Building charge per acre of irrigable land: $52.

Annual operation and maintenance charge: $1 per acre vested water rights; 80 cents for 2 acre-feet, $1.05 for 3 acre-feet, $1.65 for 4 acre-feet, and 80 cents additional for each acre-foot thereafter for public notice lands.

TIETON UNIT.

Dates of public notices and orders: November 7, 1910; March 8, April 14, 1911; January 24, February 21, April 18, May 10, 1912; March 21, April 25, June 16, 1913; March 4, September 24, 1914; March 9, March 20, October 30, 1915; March 16, April 3, 1916.

Location of lands opened: Tps. 12 to 15 N., Rs. 16 to 18 E., Willamette meridian.

Present status of irrigable lands opened; 2,009 acres entered subject to the reclamation act; 81.13 acres open to entry; 1,650 acres of State land, of which 720 acres have been applied for; 329 acres of railroad land. of which 132.3 acres have been applied for; 25,989.19 acres in private ownership covered by water-right application; 2.798.15 acres in private ownership unapplied for.

Duty of water: That quantity of water which shall be beneficially used for the irrigation of the lands and in no case exceed the share proportionate to irrigable acreage of water supply actually available. The average use is about 2 acre-feet per acre delivered at the farm.

Limit of area of farm units: Public, 40 acres; private, 160 acres.

Building charge per acre of irrigable land: $93.

Annual operation and maintenance charge: Minimum, $1 per acre of irrigable land for 1 acre-foot or less; additional quantities to be delivered where needed and charged for as follows: 50 cents for the first acre-foot and at the rate of 75 cents per acre-foot thereafter.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys in 1903.

Report of board of engineers recommending construction October 16, 1905.

Construction of Sunnyside and Tieton units authorized by Secretary December 12, 1905; Wapato unit, June 16, 1906.

Sunnyside Canal purchased June 23, 1906.

First irrigation by Reclamation Service, Sunnyside unit, season of 1907.

Tieton diversion dam completed December, 1908.

Tieton Main Canal completed in 1909.

Bumping Lake Dam completed in 1910.

First irrigation by Reclamation Service, Tieton unit, season of 1911.

Distribution system, Sunnyside unit, completed in 1911.

Tieton unit completed winter of 1911–12.

Kachess Dam completed fall of 1912.

Warren Act contract with Kittitas reclamation district executed by Secretary of Interior January 18, 1913.

Contract with Sunnyside irrigation district signed October 6, 1914.

Contract with Snipes Mountain irrigation district signed November 16, 1914.

Contract with Outlook irrigation district signed November 23, 1914.

Completion of Bumping Lake Reservoir clearing October 15, 1915.

Clear Creek Dam completed November, 1915.

Construction for Sunnyside irrigation district (Benton extension) completed April, 1916.

Construction for Outlook irrigation district completed June 1, 1916.

Construction for Snipes Mountain irrigation district completed June 30, 1916.

Per cent completed June 30, 1916: Storage unit, 33.5 per cent; Sunnyside unit, 85 per cent; Tieton unit, 98 per cent.

IRRIGATION PLAN.

The irrigation plan of the Yakima project provides for the storage of flood waters of the Yakima River and its tributaries in Kachess, Keechelus, Clealum, and Bumping Lakes, and in a reservoir at McAlister Meadows; the diversion of water from the Yakima River for the irrigation of 62,000 acres of land on both sides of the river in the vicinity of Ellensburg, comprising the Kittitas unit; the diversion of water from the east bank of the Yakima River near Parker for the irrigation of 110,828 acres of land by means of the old Sunnyside Canal, as improved and extended by the Reclamation Service, comprising the Sunnyside unit; the diversion of water from the Tieton River below McAlister Meadows (a reservoir being provided on the headwaters of this stream to regulate diurnal flow) for the irrigation of 34,000 acres of land lying between the Naches River and Ahtanum Creek, in the vicinity of North Yakima, comprising the Tieton unit; and the diversion of water from the west bank of the Yakima River near Parker for the irrigation by means of the canal system of the Yakima Indian Reservation, improved and extended, of 106,000 acres of land by gravity and 14,000 acres of land by pumping with power developed at drops in the canals, comprising the Wapato unit. The plan also provides for the development of power from drops in the main canals and laterals of the Sunnyside and Tieton units to be used for pumping irrigation water and for other purposes. The United States claims all waste, seepage, spring, and percolating water arising within the project and proposes to use such water in connection therewith.

The following features of the above plan have been completed: Sunnyside unit: Diversion dam, enlargement of main canal, Sulphur Creek wasteway, and the distribution system, with the exception of small laterals, etc., to lands not yet applied for; Benton extension (Sunnyside irrigation district); Snipes Mountain irrigation district (pumping unit); Outlook irrigation district (pumping unit). Tieton unit: Bumping Lake storage dam, Clear Creek Dam, extension of Tieton Canyon road to site of Clear Creek regulating reservoir on the headwaters of the Tieton River, Tieton River diversion dam, main canal, and distribution system. Storage unit: Kachess Dam; construction work is in progress on Keechelus Dam, the clearing of reservoir sites at Bumping Lake, Lakes Kachess, Keechelus, and Clealum. The features for future construction are: Grandview, Mabton, and Prosser pumping plants and Granger siphon, with necessary distribution systems; Clealum and McAlister Meadows Reservoirs.

SUMMARY OF GENERAL DATA FOR YAKIMA PROJECT TO JUNE 30, 1916.

STORAGE UNIT.

Finances:			
Estimated cost of completed project			$7,354,700.00
Total construction cost to June 30, 1916			$2,172,734.21
Per cent complete, June 30, 1916			33.5
Appropriation for fiscal year 1917, total, Yakima project			$798,000.00
Allotment for construction, fiscal year 1917			$480,000.00
Estimated per cent complete, June 30, 1917			36
Appropriation, fiscal year 1916			$560,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$244.818.49		
Transfers	16,614.73		
		$261,433.22	
Registered liabilities, chargeable to 1916 appropriation		50,696.55	
			312,129.77
Unencumbered balance, July 1, 1916			247,870.23

Repayments:			
Construction charges—			
Accrued to June 30, 1916			$200,000.00
Collected to June 30, 1916			200,000.00
Water rental charges—			
Accrued to June 30, 1916			14,935.00
Collected to June 30, 1916			14,935.00

SUNNYSIDE UNIT.

Areas:			
Irrigable acreage when project is complete			110,828
Public land entered, June 30, 1916	2,604		
State land, June 30, 1916	1,158		
Private land, June 30, 1916	107,066		
Acreage service could have supplied season of 1915			81,807
Addition in fiscal year 1916			11,419
Estimated addition in fiscal year 1917			3,950
Estimated acreage service can supply July 1, 1917			97,176
Acreage actually irrigated, season of 1915			66,607
Acreage cropped under irrigation, season of 1915			54,919
Crops:			
Value of irrigated crops, season of 1915			$2,750,326.00
Value of irrigated crops per acre cropped			50.08
Finances:			
Estimated cost of completed project			$3,473,894.00
Total construction cost to June 30, 1916			$2,911,046.01
Per cent complete, June 30, 1916			85
Appropriation for fiscal year 1917, total			$437,200.00
Allotment for construction, fiscal year 1917			$254,400.00
Estimated per cent complete, June 30, 1917			91
Announced construction charges per acre			$52.00
Appropriation, fiscal year 1916			$638,000.00
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$203,533.26		
Transfers	16,857.62		
		$220,390.88	
Registered liabilities chargeable to 1916 appropriation		17,866.55	
			238,257.48
Unencumbered balance, July 1, 1916			399,742.57
Repayments:			
Construction charges—			
Accrued to June 30, 1916			711,052.07
Collected to June 30, 1916			679,228.37
Uncollected, June 30, 1916			31,823.70
Operation and maintenance charges (public notice and all others)—			
Accrued to June 30, 1916			577,856.98
Collected to June 30, 1916			543,315.97
Uncollected, June 30, 1916			34,541.01
Water rental charges—			
Accrued to June 30, 1916			39,931.63
Collected to June 30, 1916			39,931.63
Drainage:			
Cost of drainage works to June 30, 1916 (investigation)			11,418.80

TIETON UNIT.

Areas:			
Irrigible acreage when project is complete			35,736.00
Public land entered June 30, 1916		2,009	
Public land open to entry June 30, 1916		2,087	
Public land withdrawn, June 30, 1916		93	
State and railroad land, June 30, 1916		3,137	
Private land, June 30, 1916		29,568	
Acreage service could have supplied season of 1915			28,000.00
Addition in fiscal year 1916			1,000.00
Estimated addition in fiscal year 1917			1,000.00
Estimated acreage service can supply July 1, 1917			30,000.00
Acreage actually irrigated, season of 1915			22,000.00
Acreage cropped under irrigation, season of 1915			18,100.00
Crops:			
Value of irrigated crops, season of 1915			$668,650.00
Value of irrigated crops per acre cropped			$37.00
Finances:			
Estimated cost of completed project			$3,169,271.96
Total construction cost to June 30, 1916			$3,130,471.96
Per cent complete, June 30, 1916			98
Appropriation for fiscal year 1917, total			$104,800.00
Allotment for construction, fiscal year 1917			$38,800.00
Estimated per cent complete, June 30, 1917			100
Announced construction charges per acre			$93.00
Appropriation, fiscal year 1916			$52,000.00
Expenditure during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$38,087.62		
Transfers	4,131.90		
		$42,219.52	
Registered liabilities chargeable to 1916 appropriation		4,654.52	
			46,874.04
Unencumbered balance, July 1, 1916			5,125.96
Repayments:			
Construction charges—			
Accrued to June 30, 1916			285,985.22
Collected to June 30, 1916			267,442.65
Uncollected, June 30, 1916			18,542.57
Operation and maintenance charges (public notice)—			
Accrued to June 30, 1916			165,517.65
Collected to June 30, 1916			150,262.77
Uncollected, June 30, 1916			15,254.88
Water rental charges—			
Accrued to June 30, 1916			4,048.50
Collected to June 30, 1916			4,048.50

STORAGE UNIT.

History of Construction and Engineering Features.

GENERAL.

At the headwaters of the Yakima River and its tributaries are the reservoir sites which, when developed, will have a total capacity of 1,085,360 acre-feet. Prior to this year the Bumping Lake and

Kachess Lake Reservoirs were completed and the first stage of Clear Creek Reservoir is completed, giving a combined storage capacity of 245,700 acre-feet. Lake Keechelus, with a capacity of 152,000 acre-feet, is now under construction, while those yet to be constructed are Lake Clealum and Tieton (McAllister Meadows), with a combined capacity of 686,000 acre-feet.

BUMPING LAKE DAM.

Bumping Lake, located at the head of Bumping River, a tributary of Naches River, at an altitude of 3,400 feet above sea level, has a surface area of 1,300 acres and a storage capacity of 34,000 acre-feet. The reservoir is formed by an earth-fill dam having a maximum height of 50 feet, a crest length of about 3,500 feet, and a volume of 233,850 cubic yards. A spillway 235 feet long, about 40 feet above the stream bed, is provided for the disposal of excess flood water. The first attempt at the construction of a dam at this location was made by the Northern Pacific, Yakima & Kittitas Irrigation Co. in 1894. Timber for the construction of a crib dam was cut, but lack of funds prevented further development. Proposals for the construction of the earthen dam described above were requested by the Reclamation Service for opening on November 15, 1906. No proposals were received and the work was readvertised under specifications to be opened July 1, 1907, but no proposals were received at that time. A road to the dam site was begun in the summer of 1906 by the State and county organizations, and was completed by the Reclamation Service by Government forces on December 10, 1908. About the same time a telephone line to the dam site was completed. Preparatory work at the dam site, including the clearing of the site and building of camp structures, and purchase and hauling of equipment and supplies, was begun as soon as the road was completed. Construction work on the dam was begun May 17, 1909. The placing of concrete in the outlet conduit was begun on August 6, 1909, and was completed prior to the suspension of work for the season in the latter part of November. At that time 55,000 cubic yards of material had been placed in the embankment. Work was resumed April 20, 1910. Considerable difficulty was encountered in getting teams, supplies, etc., into camp on account of the snow. The preliminary work consisted of placing tents on old frames, getting track and steam shovel in shape, and getting out trestle timbers.

Early in the season the spillway approach was grubbed, additional clearing was done for the borrow pit, the excavation of the cut-off trench on the north dam was started, and a trestle was built across the river to carry material from the borrow pit to the north dam.

The steam shovel in the borrow pit started May 13, and the embankment work started soon after. The material was hauled from the borrow pit in trains of six 1½-cubic yard dump cars, on 2-foot-gauge track, hauled by two horses. After being hauled to the dam site the material was dumped near the slopes of the dam, and the fine material was sluiced toward the center into a settling pond, where it formed a puddle core. The rocks and some of the fine material were left on the slopes. Some of the larger rocks were thrown over the tracks to the upstream side of the dam, where they were used for riprap.

The spillway excavation was commenced May 26 and completed June 26. Some concrete was placed in 1909. The concreting operations were resumed on July 2 and were completed August 31, 1910.

All features were completed November 15, the camp was partially torn down, and equipment freighted out. The reservoir area was covered with timber and numerous attempts were made to dispose of what was merchantable, but no one could be interested. On August 1, 1910, the clearing work was started with Government forces. The timber was felled, bucked up, and burned. The work during 1910 was carried on in connection with the construction work, but after that year was done under the direction of the project manager of the Tieton unit.

KACHESS DAM.

The Kachess Dam is located on the Kachess River, about 1,700 feet below the most southerly point of Lake Kachess. It is an earthen dam, 1,400 feet long; maximum height, 60 feet, and contains 182,000 cubic yards of material. The top width is 20 feet, upstream slopes 3 to 1, downstream 2 to 1. A wide cut-off trench was excavated about 20 feet deep upstream from the center line and parallel with it at a distance of 20 to 60 feet. A narrow trench was excavated in the bottom of this trench to a depth of from 35 to 60 feet below the ground surface, in which was built a concrete core wall 2 feet thick. The outlet works consist of 1,200 feet of open channel, extending from deep water in the lake to the intake of a cut-and-cover section 1,400 feet long. This section consists of 9 by 10 foot horseshoe type conduit placed in a trench varying in depth from 30 to 55 feet. The water is discharged from this conduit into an open channel section 300 feet long and from this into a 12 by 12 foot horseshoe type conduit section 300 feet long lying under the dam. An open-channel section 700 feet long connects this conduit with the Kachess River. A spillway is located at a distance of about one-half mile from the east end of the dam in a low saddle in the ridge. The length of the weir crest is 250 feet, designed to carry 7,200 second-feet, with a head of 4 feet.

Surveys for water storage at Lake Kachess were made by the Northern Pacific, Yakima & Kittitas Irrigation Co., but construction was not undertaken by these companies. On May 30, 1903, the Cascade Canal Co. commenced the construction of a crib dam at the mouth of the lake; this work was completed on June 1, 1904. An agreement with the Cascade Canal Co. was made by the Reclamation Service and the service assumed control of this dam on April 1, 1907.

The construction by Government forces of the portion of the work scheduled for 1910 was authorized February 14, 1910. The camp was established April 25 and work on the roads, clearing, and grubbing of the sites for the structures was commenced. The work accomplished this season was the construction of a cut-off channel to allow the Kachess River to be diverted away from the site of the outlet works, excavating the outlet trench from station 11+81 to 13+53, including the intake structure. The season's work was completed January 7, 1911.

Work was resumed at the dam site March 14, 1911. Early in the year advertisements were issued for completing the work of building the dam and appurtenant structures by contract. Bids were opened April 15, but all proposals were rejected and authority given April 28 to complete the work by Government forces.

The principal work done this season was the location of the borrow pits, which required the excavation and examination of a large number of test pits; clearing and grubbing the dam site and outlet works; stripping dam site; excavating a portion of the dredged channel in front of the intakes to the lake outlet conduit; completing the excavation of the lake outlet conduit trench and finishing the lake outlet conduit to within 70 feet of the end. The lake outlet conduit trench was excavated with a drag-line excavator, the depth of cut varying from 35 to 55 feet. The trench for the conduit under the dam and the greater portion of the outlet channel below the dam were completed. This excavation was done with a 45-ton steam shovel making as many as five cuts where the depth of cut was a maximum. Concrete was placed in the base of the tower and in the conduit through the dam.

The cut-off trench under the dam, including the core-wall trench, was completed and practically all the concrete placed in the core wall. Some backfilling of the conduit trench through the dam and the cut-off trench was done during the latter part of the season. The spillway channel was cleared, grubbed, and excavated and some paving was placed. Two hundred and forty-five thousand cubic yards of material were excavated and 5,800 cubic yards of concrete placed during this season. The season's work was completed December 20, 1911.

Construction work was again started March 4, 1912. During this season all features were completed. This involved the placing of practically all the embankment material, amounting to 182,000 cubic yards; the excavating of 70,600 cubic yards; and the placing of 2,500 cubic yards of concrete and 8,600 cubic yards of riprap. The construction of the embankment was commenced in April, 1912. Practically all the material was obtained from two borrow pits, one located at the east end and one about 1¼ miles southeast of the east end of the dam. The material was all hauled in 1½-yard dump cars in trains of 12 to 15 cars drawn by 9-ton dinkey locomotives. A 45-ton steam shovel worked in the pit, which furnished the tight material for the upstream portion of the embankment, and a 65-ton drag-line excavator loaded the material from the gravel pit. The average length of haul for the dirt was 1,100 feet and for the gravel 3,500 feet.

After the material was dumped from a trestle built on the center line and to the top of the dam, it was spread with fresnos, sprinkled, and rolled. Rocks suitable for riprap, obtained from the embankment material, were hauled to the upstream slope of the dam and placed, forming a 2-foot layer of riprap.

Practically all work in connection with the dam and appurtenant structures was completed on schedule time, except a few minor details.

The timber on the reservoir site was sold to F. C. Westcott in 1909, but as he did nothing toward carrying out the terms of his contract it was suspended in 1912 and preparations begun for doing the work by Government forces. Work was begun September 23 and discontinued December 1. During this time about 879,000 feet, b. m., of timber were cut and skidded to the lake, and about 163 acres were swamped.

Clearing and logging operations were resumed in April, 1913. Camps were erected and the work pushed as much as possible. Most of the work was done at the lower end of the lake and at the narrows between the two lakes. In all about 5,250,000 feet, b. m., of timber were cut and skidded into the lake, and 367 acres were cleared. The timber camps were practically closed down at the end of the year. Work was resumed March 26, 1914. The logging operations were continued and consisted mainly in cutting, bucking, and skidding the logs into the lake by means of a donkey engine mounted on a raft. A total of 5,073,000 feet, b. m., of timber was put into the lake this season, making a total of over 10,000,000 feet, b. m., to date. During the year 266 acres were cleared. Numerous attempts were made to dispose of the logs but without much success. A contract was entered into for the sale of cordwood, which resulted in the construction of a small sawmill at Easton where the unmerchantable timber was cut up into ties and cordwood. Operations were suspended about December 31.

At a board meeting held to consider the cost of storage it was decided that it was unnecessary to continue with the clearing and logging operations, except to carry out the wood contract already entered into. Therefore, no work has been done since December, 1914. Early in the year 1916 contracts were entered into for the sale of all logs stored in the lake and at the end of this fiscal year the contractor was engaged in carrying out the provisions of his contract.

KEECHELUS DAM.

Keechelus Dam is located at the foot of Lake Keechelus, in Kittitas County, Wash. It is to be of the earth and gravel type, 6,500 feet long; maximum fill of 68 feet, and will contain approximately 511,000 cubic yards of material. The top width will be 20 feet, with upstream slope 3 to 1 and downstream slope 2 to 1. A wide cut-off trench will be excavated the full length of the dam and a cut-off wall constructed of concrete or sheet piling in the bottom of this trench. The depth of the cut-off varies from 2 to 25 feet, the maximum depth being under the dam across the old river channel. The present lake level will be lowered 30 feet by means of the outlet works, which will be 4,300 feet long, 500 feet of which will be a 12 by 12 feet horseshoe-type conduit under the dam and the remaining 3,800 feet an open channel. A spillway, with a weir crest length of 300 feet, which will discharge 10,000 cubic feet per second with a 4.5-foot head, will be located at the north end of the dam and adjacent thereto.

Early attempts were made to obtain storage at this lake by the Northern Pacific, Yakima & Kittitas Irrigation Co., followed by the Cascade Lumber Co., which constructed a small dam for logging purposes. In order to provide temporary storage at Lake Keechelus the construction of a crib dam by the Reclamation Service was authorized. Advertisement for proposals for this work was twice made but no satisfactory bids were received, and the construction was undertaken by Government forces in the fall of 1906, and was completed on April 19, 1907. This dam is of the crib overflow type with three 4 by 6 foot openings controlled by flashboards, and raises the lake level about 10 feet, thus providing a storage capacity of approximately 15,000 acre feet.

Active construction work began August 8, 1912. A camp to accommodate about 100 men was built and the clearing of the dam site started. In connection with the construction of roads a few small areas were grubbed and stripped, the material being used on the roads. The camp was closed down in December, 1912. Work was resumed on March 20, 1913. The camp was enlarged to accommodate about 600 men. The clearing and grubbing of the dam site and borrow pits was completed early in the season. The stripping of the dam site was finished early in the fall and consisted in excavating approximately 55,000 cubic yards of material. The cut-off trench in the embankment section south of the river was excavated with a drag-line excavator dumping the excavated material on the upstream side of the trench, where it was later mixed with the borrow-pit material and used in building the embankment. A concrete cut-off was constructed in the bottom of the cut-off trench. This cut-off extended from 2 to 5 feet below the bottom of the trench and about 4 feet above the bottom. Sheet piling was substituted for the concrete cut-off in a number of places.

The transporting plant for handling embankment material was practically completed. It consisted of a trestle to grade across the river section with approaches on a 2 per cent grade leading up to it from either side. The rest of the track was laid on the ground near the top of the ridge on which the dam was built. A small amount of embankment material was placed this season.

The original plans called for a tunnel about 3,000 feet long on the upper end of the outlet works connecting with deep water in the lake. Below this tunnel was an open channel 2,900 feet long connecting with the Yakima River. This scheme of development would have lowered the lake surface about 50 feet. In May work was begun on the shafts, one at either end of the proposed tunnel. The shaft at the lower end was later abandoned and an adit constructed about 1,100 feet from the lower end. The shaft and adit were completed and four tunnel headings started. Heavy ground under high pressure was encountered and after a meeting of a board of consulting engineers the tunnel scheme was abandoned.

Very little work was done at the spillway site during the year and construction work came to a close December 24. The work done this season involved the clearing and grubbing of 35 acres, excavation of 207,000 cubic yards, and placing of 1,000 cubic yards of concrete and 7,300 cubic yards of embankment material.

Construction work was again started March 15, 1914. The first work done was to complete the cut-off trench south of the river. Sheet piling was driven in the bottom of this trench for a cut-off. The excavation of the cut-off trench on the dam site north of the river was also completed late in the fall. The concrete cut-off in the bottom of the trench was also completed.

The embankment work was started early in April and continued throughout the season. The working area was confined to the section south of the river. After the outlet tunnel was abandoned the revised plans called for an open channel located for the most part in the old river bed and connecting at the lower end to the outlet channel excavated in 1913, extending from the proposed tunnel outlet to the river. The general method adopted was to dredge about 2,800 feet of the channel and excavate the remainder with a drag-line excavator. The drag line completed its work early in September, and the dredge worked continuously from June 16 to the end of the year. Some work was done at the spillway site, excavating the spillway approach channel, and during the latter part of the season the steam shovel was used in excavating rock from the spillway site for riprap purposes.

During this season the principal items of work accomplished were: Clearing, 12 acres; excavation, 290,000 cubic yards; embankment, 170,000 cubic yards; riprap, 10,500 cubic yards; and concrete, 720 cubic yards.

Actual construction work began March 1, 1915, although the dredging operations were continued throughout the winter. The work of constructing the outlet works under the embankment was started early. Two cofferdams and a diversion flume were constructed at the site and excavation for the conduit was begun early in June. The material was excavated by hand, loaded into skips, and hoisted out of the channel. This work was rushed as much as possible, three shifts being used. The excavation for the gate tower was being done along with the hand work above referred to.

Concreting operations were begun about the middle of June and continued to the end of the fiscal year.

All excavation for the core wall was completed in 1914 except the section across the old river channel. This work was started soon after the cofferdams and diversion flume were completed. The work consisted of building a concrete core wall in a trench which extended about 24 feet below the subgrade of the conduit. Excavation of the trench was started late in the fiscal year.

Early in April the placing of the material in the embankment was started and this work was progressing nicely at the end of the fiscal year.

The placing of riprap on the upstream face of the dam was started April 2; rock excavated from the spillway site was used for this purpose.

A contract was made on February 1, 1909, with the Flanagan Mining Co. for the removal of the merchantable timber on the reservoir area of Lake Keechelus. The total estimated amount of timber to be cut was 28,000,000 feet, b. m., and a period of 10 years was provided for its completion. During the years 1909–1913, inclusive, the contractor cut but 1,216,000 feet, b. m. No more work was done up to the end of the fiscal year 1915.

CLEALUM DAM.

Lake Clealum is located on Clealum River at an altitude of 2,100 feet above sea level. An earth fill dam with a maximum height of 120 feet, a crest length of 700 feet, and a volume of 425,000 cubic yards will be built at the outlet of the lake. An outlet tunnel approximately 2½ miles long will be built from the lake to the Yakima River, thereby obtaining 117,500 acre-feet of substorage. Two spillways, each 210 feet long, will provide for an overflow of 18,000 second-feet. The storage capacity when completed will be 501,000 acre-feet.

Surveys and cutting of timber for the construction of a dam at Lake Clealum were undertaken by the Northern Pacific, Yakima & Kittitas Irrigation Co., and by the Washington Irrigation Co. In March, 1905, the construction of a low crib dam was begun by the Union Gap Irrigation Co., but this dam was destroyed by the Washington Irrigation Co. Agreements with these companies were made by the Reclamation Service and plans were prepared for a temporary crib dam similar to that at Lake Keechelus. As no satisfactory proposals for the work were received, construction was begun by Government forces in the fall of 1906 and completed November 9, 1907. This dam is of the crib overflow type with a spillway 200 feet long and five 4 by 6 foot openings controlled by flashboards, and raises the level of the lake about 12 feet, thus providing a storage capacity of about 24,000 acre-feet. The construction of the large permanent dam will be undertaken when funds are available and the storage capacity is required.

TIETON (M'ALLISTER MEADOWS) DAM.

The proposed Tieton Reservoir is located on the Tieton River at McAllister Meadows at an altitude of 2,800 feet above sea level. The reservoir will be formed by constructing a dam 195 feet in height and 1,000 feet long, which will contain 991,000 cubic yards. A spillway with a weir 350 feet long will be constructed in rock at the north end of the dam. The outlet works will consist of a tunnel 1,500 feet long through the solid rock cliff at the north end of the dam; suitable gate control will be provided. The capacity of the reservoir when completed will be 185,000 acre-feet.

Surveys were first made in 1909 and additional investigation work was done during 1909 and 1914. Preliminary plans have been completed and approved.

Construction During Fiscal Year 1916.

Kachess, Clealum, and Tieton Dams.—No construction work was done at the dam sites during the year. Operation and maintenance of the permanent dam at Lake Kachess and the crib dam at Lake Clealum were continued throughout the year.

Keechelus Dam.—During the year all the concrete was placed in the conduit through the dam, and the gate tower was completed to elevation 2482. The back filling of the conduit trench was 65 per cent completed at the end of the year.

The excavating of the core wall trench across the river section was completed August 11, 1915, and concreting operations started soon after. At the end of the fiscal year all concrete was placed in the core wayy, which included the raising of the wall to a point about 35 feet above the conduit subgrade.

Embankment material was placed when weather conditions would permit. By the end of the year the dam south of the river was completed for a distance of 3,200 feet and approximately 1,200 feet north of the river were approximately up to grade, leaving about 2,000 feet yet to be completed.

On account of striking solid rock in the borrow pit for tight material, a new pit was opened up late in the season of 1915. The placing of riprap on the upstream face of the dam was done throughout the year, except during the winter; this work practically kept pace with the embankment.

The only work done at the spillway site was the excavation of rock to be used for riprap on the dam.

The work accomplished during the year was as follows: Excavation, 167,630 cubic yards; concrete, 5,689 cubic yards; embankment, 147,590 cubic yards, and riprap 13,590 cubic yards.

The Keechelus dam is 86 per cent completed.

Clearing reservoir sites.—The portion of the reservoir areas at Bumping Lake, Clealum, Kachess, and Keechelus Lakes that will be submerged by reason of the construction of the permanent dams is covered with a heavy growth of timber which is to be removed before the water is raised. The clearing of the area at Bumping Lake is completed. Work of clearing the Kachess reservoir site was suspended at the end of the season of 1914, after approximately 10,000,000 feet, b. m., of timber had been cut and put into the lake. Approximately 650 acres were cleared.

At Lake Keechelus during 1915 negotiations were begun which resulted in a cancellation of the contract with the Flanagan Lumber Co., which had the contract for clearing the reservoir. This contract of rescission was approved on October 23, 1915, and permission given to readvertise the work. Bids were opened on December 1, 1915, but were all rejected and authority given to carry out the work with Government forces. On June 19 a contract with the Kittitas Lumber Co. was approved by the department whereby all merchantable timber is to be taken by the company and paid for at the prevailing rates for logs on Puget Sound. The company has begun the erection of a sawmill at the lake, and all logs will be manufactured into lumber. At the close of the fiscal year both the clearing and logging were well started, and approximately 41 acres had been cleared.

The clearing at Lake Clealum is being done under contract with the Roslyn Lumber Co. Approximately 1,493,000 feet, b. m., were cut and sawed.

Board Meetings.

July 17, 1909, at Bumping Lake, Wash. Personnel: A. P. Davis, chief engineer; D. C. Henny, consulting engineer; and C. H. Swigart, supervising engineer. Subject: Investigation of conditions at the dam and method of construction.

January 14, 1911, at North Yakima, Wash. Personnel: A. P. Davis, chief engineer; D. C. Henny, consulting engineer; C. H. Swigart, supervising engineer; and E. H. Baldwin, project engineer. Subject: Study of investigations and designs, Keechelus Dam.

February 15 to 25, 1912, at North Yakima, Wash. Personnel: A. P. Davis, chief engineer; D. C. Henny, consulting engineer; H. N. Savage, supervising engineer; and E. H. Baldwin, project engineer. Subject: Problems relating to storage unit and particularly the development of Keechelus Reservoir.

July 15, 1913, at Meadow Creek, Wash. Personnel: A. P. Davis, chief engineer; D. C. Henny, consulting engineer; C. H. Swigart, supervising engineer; and C. E. Crownover, project engineer. Subject: Gate control and tunnel operations, Keechelus Dam.

December 15, 1913, at Meadow Creek, Wash. Personnel: D. C. Henny and A. J. Wiley, consulting engineers; C. H. Swigart, supervising engineer; and C. E. Crownover, project engineer. Subject: Keechelus outlet works and abandoning tunnel construction.

June 18, 1914, at Meadow Creek, Wash. Personnel: D. C. Henny, consulting engineer; E. McCulloh and C. E. Crownover, project engineers. Subject: Flanagan Lumber Co. contract for removal of timber at Lake Keechelus.

February 21 to 27, 1915, at North Yakima, Wash. Personnel: D. C. Henny and A. J. Wiley, consulting engineers; C. H. Swigart, supervising engineer; and C. E. Crownover, project engineer. Subject: Storage cost division.

April 21 to 24, 1915, at North Yakima, Wash. Personnel: D. C. Henny and A. J. Wiley, consulting engineers; F. Teichman, engineer; C. H. Swigart, supervising engineer; and C. E. Crownover, project engineer. Subject: Keechelus Reservoir outlet control.

SUNNYSIDE UNIT.

History of Construction and Engineering Features.

SUNNYSIDE CANAL SYSTEM.

The Sunnyside Canal system was acquired by purchase from the Washington Irrigation Co. in December, 1905. The system at that time consisted of a movable diversion dam and wooden headworks structure; a main canal about 56 miles long; two main laterals with a total length of about 25 miles; about 50 miles of smaller laterals; a telephone system of about 58 miles of line; a wasteway at mile 17 on the Main Canal known as the Zillah wasteway; eight houses for canal riders; and a headquarters building in the town of Zillah. The Main Canal had a maximum capacity of 650 second-feet, decreasing gradually to a capacity of 50 second-feet at the end. All structures along the Main Canal and throughout the distribution system were of wood and in a poor state of repair. The system as purchased was deemed sufficient to irrigate approximately 65,000 acres of land, of which about 36,000 acres were under cultivation.

Since the acquisition of the system by the United States, it has been gradually extended and enlarged until it now embraces about 60 miles of main canal, with a capacity of 1,200 second-feet at the intake and 157 second-feet at the end; 50 miles of branch canals with capacities varying from 30 second-feet to 190 second-feet; 460 miles of laterals and sublaterals of capacities of 30 second-feet or less; three main canal wasteways at miles 17, 37, and 60, respectively; 124 miles of telephone; 17 houses for canal riders; the old headquarters building at Zillah; and the present headquarters buildings at Sunnyside. The present irrigable area is 110,828 acres, of which about 92,000 acres are irrigable by gravity flow from the main canal, and the balance by pumping plants, the power for which is developed at various points in the gravity system.

DIVERSION DAM.

The first work of the Reclamation Service was the construction of a new concrete diversion dam across the Yakima River at the Main Canal intake. This dam is of the ogee type, 8.5 feet high, 20 feet wide including the apron, and 500 feet long. A fish ladder and sluiceway are provided near the north abutment. The work involved the construction of an earth levee about 1 mile in length containing 18,000 cubic yards of material. The old masonry gate house was raised and enlarged, and concrete headworks built for the canal consisting of six cast-iron gates 6 feet square, supplemented by emergency gates of the Taintor type. This work was started in October, 1906, and completed in October, 1907. The work was done by Government forces and was seriously hampered and delayed by a very heavy flood in the river in November, 1906, and by high water from May to July, 1907.

ENLARGEMENT AND EXTENSION OF MAIN CANAL.

The enlargement and extension as originally planned of the Main Canal contemplated the irrigation of 100,000 acres, with a main canal capacity of 1,076 second-feet at the intake and 57 second-feet at the end. This work was started in 1908 and completed in 1912. The enlargement of the Main Canal from the intake to mile 20.6 was done with a Bucyrus elevator dredge of the floating type, which started work in November, 1909, and was operated continuously until August, 1911, when the dredge was dismantled. From mile 20.6 to mile 43 the enlargement of the canal was accomplished by a Lidgerwood-Crawford drag-line excavator, which started work in February, 1909, and which was operated continuously until September, 1911, when the work of this machine was finished. These machines were operated by Government forces. The raising and strengthening of the canal banks throughout the entire length of canal and the removal of such material as was inaccessible to the machines or which could not be handled by them, as well as the enlargement of the canal below mile 43, were done with teams. The teamwork was largely done by Government forces in the nonirrigation season during the years 1909 to 1912, inclusive. The extension of the Main Canal to mile 59.6 was done in 1908 by teamwork under contract. At the same time the distribution system to serve the area under this extension and a concrete overflow weir at the end of the canal, 50 feet in length, discharging into a natural drainage channel leading to the Yakima River, were built by Government forces.

In 1914, because of the contemplated extension of the Main Canal to Benton City to serve lands in the Sunnyside irrigation district, and the contemplated construction of the pumping plants to serve lands in the Snipes Mountain, Outlook, and Grandview irrigation districts, it was determined to further enlarge the Main Canal to 1,200 second-feet capacity at the intake and 157 second-feet at mile 59.6. To obtain this increased capacity in the Main Canal from the intake to mile 50.5, it was decided to provide for an increased velocity in the canal by riprapping with loose gravel those portions of the canal banks where erosion was apt to occur. From mile 50.5 to mile 59.6 an actual enlargement of the canal by teams was necessitated. Provision was made for use of flashboards on the diversion dam to give the increased capacity at the Main Canal intake; the wooden flume at mile 55 was replaced by a steel flume of greater capacity, and the overflow weir at mile 59.6 increased to 75 feet in length. The enlargement of the canal and the erection of the structures were accomplished by Government forces during the period from November, 1914, to March, 1915. About 11 miles of canal bank were riprapped during this same interval and about 3 miles in the following winter. The gravel for riprapping was furnished and hauled by contract; the preparation of canal banks and the placing of the gravel were done by Government forces.

The enlargement of the Main Canal made necessary changes in the hydraulic gradient. To meet this and to replace such wooden checks as existed, vertical drops from 2 to 3 miles apart were planned. These structures were built of reinforced concrete and were divided into bays by steel brackets anchored on concrete piers and providing for the use of wooden flashboards in the operation of the canal. It was also determined to replace all of the wooden turnouts by turnouts of more permanent construction. There were approximately 200 turnouts, four with capacities in excess of 50 second-feet; fourteen with capacities of 10 to 50 second-feet; the remainder with less than 10 second-feet capacity. The larger turnouts were built of reinforced concrete with cast-iron gates; the smaller ones of concrete and steel pipe with structural steel gate frame projecting into the water section. To provide for runoff from the hills above the Main Canal, nine large concrete and tile culverts were constructed under the canal. The enlargement of the canal also made necessary the reconstruction of 14 highway bridges. All of the various structures connected with the canal enlargement and betterment were built by Government forces during the nonirrigation seasons of 1907–1915, inclusive. In 1910 the construction of the Oregon-Washington Railroad & Navigation Co. made necessary the relocation and reconstruction of about one-half mile of Main Canal at mile 48.5, including the construction of a reinforced concrete check; this work was done by the railroad forces.

ZILLAH WASTEWAY.

At the time of purchase of the canal system the Zillah wasteway at mile 17 on the Main Canal was a wooden structure with flashboard control at the canal. From the canal to the river, approximately 2,000 feet away, an open channel, except for 500 feet of concrete conduit, had been cut. This was replaced by a concrete and wooden chute extending from the canal to the river and a reinforced concrete check and diversion pool constructed at the place of diversion from the Main Canal. The headworks consist of five turbine-operated gates set below the grade of the canal, and are designed to take the full flow of the Main Canal at this point. This structure was started in the spring of 1907 and completed in February, 1908; the work was done by Government forces.

SULPHUR CREEK WASTEWAY.

To provide aditional means of relief for the Main Canal in times of emergency, and also to provide the main drain for the reclamation of the water-logged lands in the vicinity of Sunnyside, it was determined to build the Sulphur Creek wasteway. Under date of February 28, 1908, a report was submitted by a board of engineers consisting of E. G. Hopson, C. H. Swigart, and E. McCulloh, relative to the construction of this feature.

Sulphur Creek wasteway leaves the Main Canal at mile 36.80. The headworks consist of three turbine-operated gates, taking water from a concrete pool below a check in the Main Canal. The first 6,000 feet are of semicircular cross section built of reinforced concrete. An earth section then extends southerly some 8 miles through the Sunnyside district to the Yakima River. The greater part of this section is lined with wooden cunette to maintain the alignment and grade and prevent excessive erosion. The excessive grade in the earth section is taken up by 19 concrete drops. The depth of the section is from 8 to 12 feet, as it is designed to act also as an outlet for drainage ditches, serving approximately 25,000 acres.

Contract for the construction of the lined section was executed in August, 1909, and this portion of the work was completed by the contractor in December, 1910. The headworks and check in the Main Canal at this point were built by Government forces in 1910. A contract for the excavation of the earth section was executed August 15, 1908, but the contractors abandoned the work in June, 1909, and the contract was suspended June 19, 1909. Another contract was entered into for its completion June 30, 1909, but the contractor abandoned the work June 27, 1910. This contract was then suspended and plans made to complete the work by Government forces. The excavation was completed by Government forces in September, 1910, and the structures in November, 1910.

SNIPES MOUNTAIN CANAL.

The Snipes Mountain Canal, diverting from the Main Canal at mile 30, was the larger of the two main laterals existing when the system was purchased. This canal is about 12 miles in length and, with its branches, is designed to irrigate approximately 13,000 acres of land. The earth section was enlarged by teamwork from a maximum capacity of 90 second-feet to a maximum capacity of 190 second-feet. All wooden structures were replaced by permanent structures, additional drops and turnouts built, and the reach from mile 2.3 to 3.3 lined with concrete. Nine miles of the canal enlargement and three of the reinforced concrete drops were built by contract forces and the remainder of the work by Government forces. The enlargement of the canal, the installation of new structures, and the replacement of old structures were started in 1910 and continued at intervals as the development of the lands under this canal necessitated greater capacity; the work was completed in 1915. The concrete lining was done in November and December, 1915. The concrete headworks were built jointly with a check in the Main Canal at the point of diversion in the winter of 1910–11.

MABTON CANAL.

The Mabton Canal, diverting from the Main Canal at mile 50.35, serves about 10,000 acres lying south and on the opposite side of the Yakima River from the main project. This canal consists of 1.5 miles of open feeder canal; about 3 miles of reinforced concrete and wood stave pipe; and 10 miles of main lateral with the necessary distribution system. The river crossing is accomplished by means of 48-inch diameter wood stave pipes placed beneath the river bed, operating under a maximum head of 170 feet. This feature was included in the report of February 24, 1908, of a board of engineers composed of E. G. Hopson, C. H. Swigart, and E. McCulloh, and construction was authorized April 27,1908. The feeder canal,siphon, and main lateral with a small portion of the distribution system were completed prior to the irrigation season of 1909. The wood stave pipes and main lateral, including nine large wooden flumes, were built by contract forces; the remainder of the work was done by Government forces. Following this work the distribution system on this division was constructed as warranted by the development of the land and was finally completed in 1912.

PROSSER CANAL.

The Prosser Canal, diverting from the Main Canal at mile 55, serves about 3,000 acres on the south side of the Yakima River. This canal consists of a feeder canal about one-half mile long, about 2 miles of 30½-inch concrete and wood stave pipe, carried across the Yakima River by a steel bridge, and about 4 miles of main lateral with the necessary distribution system. This work was authorized in the fall of 1910, and the bridge, pipe line, and main laterals, including two steel flumes, were completed in the spring of 1911; the distribution system was completed the following summer. All of this work was done by Government forces except the construction of the wood stave pipe line and the fabrication and erection of the steel bridge spans.

BENTON EXTENSION.

October 6, 1914, contract was signed with the Sunnyside irrigation district whereby the Sunnyside Canal was extended eastward some 14 miles in order to deliver water to about 4,600 acres tributary to Benton City. This extension, known as the Benton Canal, consisted of the construction of a canal with a maximum capacity of 75 second-feet 14 miles long, including six wood stave pipe siphons from 40 to 48 inches diameter, two steel flumes, and those portions of the distribution system with a capacity in excess of 10 second-feet. The excavation was done by men and teams under contract, the wood stave pipes and flumes were built by contract, and all concrete work and the installation of small structures by Government forces. This construction was completed in May, 1915, having been materially delayed by the severe winter of 1914-15. Water was delivered to the district in June, 1915.

SNIPES MOUNTAIN IRRIGATION DISTRICT.

November 16, 1914, contract was signed with the Snipes Mountain irrigation district involving the construction of the necessary pumping plants and lateral system for the irrigation of about 1,915 acres of land west of Sunnyside and adjacent to and above gravity flow from the Snipes Mountain Canal. The distribution system consists of about 2½ miles of small open ditches lined with concrete and about 10 miles of vitrified clay and wood pipe lines and concrete distribution structures, all of which were built by Government forces, except the excavation for the main lateral, which was done by contract. The work on the distribution system was entirely completed June 15, 1915. Two pumping plants were constructed, located at miles 6.42 and 9.04 on Snipes Mountain Canal, and known as Hillcrest and Snipes Mountain pumping plants.

The Hillcrest plant consists of one unit, a four-stage, vertical type direct connected to turbine centrifugal pump of approximately 32 horsepower installed in a reinforced concrete house. The drive head is 32 feet, delivery head 112 feet, with 24 inches diameter penstock 170 feet long, and 10-inch delivery pipe 170 feet long, both of inserted joint wood stave pipe.

The Snipes Mountain plant consists of two units, both vertical type, direct connected to turbine centrifugal pumps, one 12-inch two stage of 360 horsepower and one 8-inch single stage of 140 horsepower installed in a reinforced concrete pump house. The drive head is 64 feet, the delivery head 190.

The penstock is a 60-inch diameter continuous wood stave pipe 1,000 feet long. The delivery pipe is also of continuous wood stave construction, 30 inches diameter, 3,400 feet long, with a maximum head of 260 feet; both pipes are built above ground on concrete pedestals.

At the Hillcrest plant the pump house, penstock, and delivery lines were built by Government forces; the machinery was furnished under contract. Construction of this plant was started in June, 1915, and completed in October, 1915, when the pump was tested and placed in operation. At the Snipes Mountain unit the pump house, concrete lined by-pass, and pedestals were built by Government forces; the machinery and wood pipe lines were furnished by contract. Construction work was started February 2, 1915, and completed May 21, when the first water was delivered to the district.

OUTLOOK IRRIGATION DISTRICT.

November 23, 1914, contract was signed with the Outlook irrigation district providing for the construction of the necessary pumping plant and distribution system for the irrigation of about 4,500 acres of land adjacent to and above the main canal due north of Outlook. The distribution system consists of about 13 miles of lateral lined with concrete, about 7 miles of vitrified clay, wood, and steel-pipe lines, and the necessary earth ditches, flumes, and structures for delivery of water to each 40-acre tract. All work on the distribution system was done by Government forces and was completed in May, 1916.

The pumping plant for this district is located at mile 30.25 on the Main Canal at the head of Snipes Mountain Canal and consists of two units, both single-stage vertical type direct connected to turbine centrifugal pumps, one of 500 horsepower and one of 220 horsepower, installed in a reinforced concrete house. The drive head is 45 feet, delivery head 109 feet. The two penstocks are of reinforced concrete, and the delivery pipe continuous wood stave 46-inch diameter, 3,800 feet long, built above ground on concrete pedestals.

The machinery was furnished under contract; the installation by Government forces was completed in December, 1915. Operation of the plant was started in April, 1916, and the small unit placed in service. Upon attempting to operate the large unit the pump casting broke. Temporary repairs were made permitting the operation for 1916 of this unit pending its complete repair. The delivery pipe was built under contract and was finished June 29, 1915. The power house, penstocks, and tailrace excavation were completed by Government forces in March, 1916.

Construction During Fiscal Year.

The construction work during the fiscal year 1916 consisted of the extension of the distribution system for lands just completing water-right application, the construction of turnouts and deliveries from the Main Canal, the placing of gravel riprap along the Main Canal from mile 0 to mile 50, the lining of Snipes Mountain Canal from mile 2.3 to 3.3, the lining with concrete of a portion of the Benton Canal for the Sunnyside irrigation district, the completion of the pumping plant and lateral system for the Outlook irrigation district, and the completion of the pumping plants for the Snipes Mountain irrigation district.

Extension of distribution system.—The extension of the distribution system consisted of the construction of small laterals, flumes, pipe lines, and wood structures necessary to carry water from existing canals or laterals to the new lands being placed under cultivation. Twelve additional farm-unit turnouts were built. Forty-three steel and concrete turnouts were built along the Main Canal, replacing old wooden turnouts.

Riprapping Main Canal.—To provide for increased quantity of water needed for the lands under the Grandview irrigation district it was decided to provide for a raised water surface and an increased velocity in the Main Canal from the intake to mile 50.5 by sloping banks and placing loose gravel riprap on the banks at those points where erosion is apt to occur. This work consisted of the placing of some 2,500 cubic yards of loose gravel on a total length of approximately 3 miles of Main Canal banks.

Snipes Mountain Canal.—The work on Snipes Mountain Canal was the lining with concrete of a fill about 1 mile in length where seepage conditions were bad and which was very dangerous to operate, as the top of the berm averaged 11 feet in width and was about 12 feet above the adjacent land. The lining was 2¼ inches thick, the bottom 11 to 13 feet in width, the water depth varying from 4.45 feet to 5.15 feet, with a 9-inch freeboard, the side slopes 1¼ to 1, with a 7-inch berm. The sand was hauled by Government forces an average of 7 miles and the gravel an average of 3 miles. The preparation of the section was started November 6 and placing of concrete on November 12; the placing of the concrete lining was completed on November 29; 1,030 cubic yards of concrete lining were placed. This work included the construction of three turnouts and one two-panel flashboard drop at mile 3.3. The entire job was completed December 6. The weather was rather severe and protection against frost was necessary throughout the work.

Benton Branch Canal.—The operation of the main lateral to the Sunnyside irrigation district (Benton Branch Canal) during the irrigation season of 1915 demonstrated the necessity of lining with concrete about 2 miles of that portion of the lateral between siphons 3 and 4, as well as about a quarter mile of this canal immediately below siphon 6. A 75-man camp was established on February 20 at Glen and preparation of canal section for lining started. About 200 cubic yards of sand were shipped to Glen from Hedges; the balance of the aggregate was hauled by Government forces from local pits, with an average haul of 5 miles. Placing of concrete was started on March 16 and completed on April 13; water was delivered to the district on April 15. Approximately 2 miles of canal were lined, involving the placing of 800 cubic yards of concrete.

The extension of the distribution system and the placing of the gravel riprap were done entirely by the regular operation and maintenance forces, and in addition supervision was given the lining with concrete of the Snipes Mountain Canal and the Benton Canal.

Outlook pumping plant.—The completion of the Outlook pumping plant comprised the installation and testing of the pumping machinery, the completion of concrete work upon the buildings and appurtenent structures, erection of roof and traveling crane, painting, grading, and seeding grounds, etc., and the completion of the tailrace excavation. The turbine-driven pumps, which were built by the Platt Iron Works, were received October 7, 1915. Installation was made by Government forces; the work was in charge of an erecting engineer furnished by the machinery manufacturers. Erection was completed December 10, 1915.

Operation of the plant was started in April, 1916. The smaller of the two pumping units was successfully placed in service, but attempted operation of the larger unit resulted in fracture of the pump casting. Pending the receipt of a new casting from the contractors, the fractured part was temporarily repaired in such a manner that the pump could be operated. An official efficiency test of the small unit was made April 29. The plant was operated by Government forces until June 1, when the operation of the plant, together with the lateral system, was placed in charge of the irrigation district in accordance with contract with the district.

Outlook irrigation district laterals.—Construction of the lateral system for the Outlook irrigation district was completed by June 1, 1916. The work during the fiscal year 1916 comprised the lining of 12.8 miles of laterals with concrete, the laying of approximately 7 miles of vitrified-pipe lines, and the construction of culverts, flumes, drops, turnouts, farm deliveries, etc., complete, as required to deliver water to each 40-acre subdivision of the district.

Hillcrest and Snipes Mountain pumping plants.—For the Snipes Mountain irrigation district, the construction of the Hillcrest pumping plant was completed, an efficiency test of the pump made, and the plant operated during October, 1915, and from April 24 to June 30, 1916. For the Snipes Mountain pumping plant, reconstruction of the pumping machinery was made by the Pelton Water Wheel Co. under supplementary contract with the Government. The new parts for the units were received and the pumps assembled during March, 1916. An official test of these pumps was made on April 20 and 21. On account of unsatisfactory performance of the pumps at this plant, operation of the plant has been conducted by the Government during the fiscal year.

Drainage.

The drainage system on the Sunnyside unit has been constructed, and is operated and maintained by drainage districts in accordance with the State law. During 1915 new districts were formed and much work done in extending the drainage system. Since 1912, 18 drains with a length of 70 miles have been completed, and 4 more are under construction. Of the 70 miles of drains, 50 miles are open ditch and 20 miles are covered tile drains, from 4 to 20 inches diameter. The total excavation for drains built or under construction approximates 1,600.000 cubic yards, at a cost of $543,000, and affects 40,200 acres of land.

Of the 18 drains built, 11, serving 21,000 acres, discharge into Sulphur Creek wasteway, which serves the twofold purpose of a relief for the Main Canal and the main artery of the drainage system for the country between Outlook and Grandview.

Operation and Maintenance.

During the fiscal year 1916, and for the first time in the history of the operation of the Sunnyside Canal by the Reclamation Service, a serious water shortage was had. For the irrigation season of 1915, up to June 30, nothing out of the usual routine incident to operation occurred.

A diversion of 1,031 second-feet was attained July 3, which proved to be the maximum for the season. At that time advice was received that the supply of storage water available was insufficient for the demands, and the diversion from the river was reduced July 9 to approximately 900 second-feet. To overcome this shortage a schedule was put into operation, whereby each ninth of the project was denied water for two days in turn, in this way maintaining the individual deliveries as of July 1. This schedule obtained until July 28, when a further reduction to 830 second-feet was made and a schedule established denying water three days to each sixth of the project in turn.

On August 10 the quantity of water available dropped to approximately 500 second-feet, and on August 12 to approximately 220 second-feet. Arrangements were then made so that all water in the Yakima River below Union Gap would be diverted in turn to the Reservation and Sunnyside Canals. This gave the Sunnyside Canal an average diversion of 500 second-feet from August 17 to 23, inclusive; 70 second-feet from August 24 to 28, inclusive; 400 second-feet from August 29 to September 7, inclusive; and 126 second-feet from September 8 to 13, inclusive. During the periods when the Sunnyside Canal received all the water in the river the Sunnyside unit was divided into two parts, and deliveries were made to each part in turn for half the period—to fruit, vegetables, and young seeding in bad shape—denying water to old alfalfa land or lands without crop at that time.

After September 13 the water below Union Gap was divided between the Reservation Canal and Sunnyside Canal in the proportion of one-third and two-thirds, respectively, the average diversion to the Sunnyside Canal from September 13 to October 3 amounting to 225 second-feet. This was distributed to each third of the project in turn on a basis of stock-water delivery. On October 4 instructions were issued to make all deliveries beginning at the upper end of the Main Canal on a stock-water basis, with September measurement to young seeding and pasture, and as the diversion from the river gradually increased deliveries were rapidly extended until on October 12 some water was being delivered to all lands. As soon as delivery was made to all lands the quantity delivered was increased in accordance with the demand as rapidly as the increasing supply permitted until October 23, when a diversion of 540 second-feet was reached and all demands were satisfied. Water was closed out of the canal on October 31.

On July 3 the project was visited by a violent windstorm, which literally filled the main and branch canals with weeds. Quick work prevented much damage, although one break occurred on the South Branch of Snipes Mountain Canal, where the plugging of a siphon under the Oregon-Washington Railroad & Navigation Co.'s tracks resulted in the water overflowing the canal bank. On September 1 siphon No. 1 on the Benton Canal washed out on the west slope of the canyon which it crosses. Approximately 175 feet of the siphon were damaged and 20 piers had to be rebuilt. The pipe itself was jacked up to grade and alignment by the use of chain blocks and jacks, and water service was resumed September 20.

During the fore part of February heavy snowfall occurred, followed by warmer weather and rains, and on February 10 a general flood condition prevailed, which developed into one of the most serious flood run-offs in the history of the project. Water from the hills collected behind the Main Canal fills in many places and formed ponds which softened the fills and broke through into the canal.

In addition to the snow, a large quantity of ice and trash of all kinds was also carried into the canal. The condition in the canal rapidly became serious until about the middle of the afternoon, when the maximum flood condition was reached. All of the water which collected in the first 17 miles of canal was diverted through the Zillah wasteway, except perhaps 50 to 100 second-feet, which the wasteway could not take.

Such water as passed the Zillah wasteway or came into the Main Canal between miles 17 and 37 was diverted through Sulphur Creek wasteway to the extent of the capacity of the wasteway. At one time over 200 second-feet were passing Sulphur Creek wasteway, in spite of the diversion made there. The water which passed Sulphur Creek wasteway or came into the Main Canal below mile 37 was diverted through Rocky Ford Canal, Mabton Canal, and the lower Main Canal. Wherever water could be diverted through any of the Main Canal turnouts these turnouts were opened. No water overflowed the lower canal banks except immediately above Spring Creek wasteway at mile 60, where it overflowed for a distance of several hundred feet above the wasteway. All wasteways were taxed to capacity, and Sulphur Creek wasteway far beyond its capacity, particularly below the inlets of the large county drains. Here the water spread out over the country on both sides of the wasteway, flooding the surrounding country and doing much damage, although none of the drops in the wasteway itself was damaged. The damage done to the canal system by this flood was repaired by the regular operation and maintenance forces without delaying the opening of the 1916 irrigation season.

For the irrigation season of 1916 water was available for 93,226 acres; 86,878 acres were under rental contract or water-right application and water was being delivered June 30 to 72,900 acres. Water was turned in the canal March 9 and gradually increased until on April 1, the opening of the season, approximately 225 second-feet were running; this amount was increased in accordance with the demand until a maximum diversion of 1,038 second-feet was reached on June 25. There was no delay in the delivery of water except to the Sunnyside irrigation district, where, because of the concrete lining of the Benton Canal between siphons No. 3 and No. 4, water delivery was not made until April 15.

The maintenance work was done for the most part during the nonirrigation season by the operating force; the water masters acted as general foremen. Canal riders were used as subforemen for the various crews organized to prosecute the work and in various capacities on the work, and additional men and teams were secured from neighboring farmers. This work consisted of the work necessary to keep the canals in condition for carrying the desired quantities of water, correction and prevention of erosion, removal of silt, strengthening of canal banks, clearing rights of way of weeds, and maintenance of houses and grounds for the canal riders. One small carpenter crew was also employed throughout the year, occupied with the repair and renewal of small structures of the project.

In addition, the following work was accomplished during the year; 50 concrete measuring boxes and 14 steel and concrete branch canal turnouts were constructed, replacing an equal number of wooden structures. At Mile 36 on the Main Canal some 600 feet of canal across an old break was rebuilt to eliminate two sharp reverse curves. At mile 43.65 on the Main Canal a four-panel flashboard concrete check was installed, 2,260 feet of 24 by 36 inch flume on lateral 57.34 were replaced by 24-inch wood stave pipe, and 25 miles of telephone line overhauled, involving resetting of nearly all poles in that distance.

Historical review, Sunnyside unit, Yakima project.

Item.	1911	1912	1913	1914	1915	1916, to June 30.
Acreage for which service was prepared to supply water	71,756	80,076	80,607	81,306	81,807	[1] 89,253
Acreage irrigated	51,040	58,560	62,800	64,100	66,607	72,900
Miles of canal operated	500	513	525	525	525	572
Water diverted (acre-feet)	275,465	314,733	312,733	316,828	314,057	[2] 276,210
Water delivered to land (acre-feet)	157,419	179,308	194,725	211,902	203,397	180,413
Per acre of land irrigated (acre-feet)	3.084	3.062	3.101	3.310	3.035	2.527

[1] Approximately 4,000 acres of new land brought under irrigation about May 1, making total of 93,226 acres.

[2] Shortage in supply of water available in river, Aug. 8 to Oct. 23, 1915.

Settlement and Development.

The project shows a slightly increased development of new lands over the previous year. The irrigable area of farms occupied and to which water was delivered increased by 2,315 acres as compared to an increase of 2,125 acres in 1914. The increase in area actually irrigated was 2,500 acres, while the increase in area actually producing remunerative crops was 5,646 acres, as compared to about 3,000 acres in 1914. The farm population shows an increase of 564, with 103 additional farms. This increase is due in a large degree to the inclusion of the Sunnyside irrigation district (Benton extension) area, where some development had been made under pumping plants previous to its addition to the project.

The steady increase in dairy cows, poultry, and other stock on the farm has represented to the farmers a constantly increasing source of cash revenue, which is evident in building improvements on the farms, silos, increased bank deposits, and increased trade with local merchants and mail-order houses. Several miles of excellent roads have been built under the project, in some instances the farmers doing the work.

Live Stock, Dairy, etc.—The tendency toward diversified farming, particularly along the lines of dairying and stock raising, continues stronger than ever. The stock census shows an increase in dairy cattle of 24 per cent as compared with 1914, and 49 per cent as compared with 1913, and in hogs of 31 per cent as compared with 1914, and 100 per cent as compared with 1913. Horses and poultry show a slight increase; sheep show a decided increase. A slight increase is shown in average value of horses and a marked increase in the average value of sheep. A decrease of $8 a head is shown in the average price of cattle and a marked decrease in the average value of hogs. The value of the stock and equipment shows an increase of $42 per farm.

The high price of hay had a tendency to keep away the usual "feeders" wintered on the project and this year there were fed but 35 head of horses, 721 head of cattle, and 49,500 head of sheep, as compared with 100 head of horses, 4,600 head of cattle and 65,500 head of sheep in 1913.

Land values.—Land values during the year reached new low levels. The best raw lands have been sold at $40 to $60 per acre. At these prices with the very easy terms of payment for water right under the extension act, there are unexcelled opportunities for settlers to make good. Some of the rougher lands which would make excellent stock farms may be had at prices as low as $60 to $100 per acre, with water right fully paid, and improved lands adapted to general farming at $125 to $250 per acre.

Settlement data, Sunnyside unit, Yakima project.

Item.	1914	1915	1916
Total number of farms on project	2,448	2,450	2,553
Population	6,900	7,270	7,844
Number of irrigated farms	2,448	2,450	2,553
Operated by owners or managers	1,912	1,910	1,898
Operated by tenants	536	540	655
Population	6,900	7,270	7,844
Number of towns	13	13	13
Population	5,300	5,460	5,268
Total population on towns and on farms	12,200	12,730	13,112
Number of public schools	34	34	34
Number of churches	30	30	30
Number of banks	9	9	9
Total capital stock	$260,000	$255,000	$309,573
Total amount of deposits	$1,248,000	$1,028,679	$1,112,296
Total number of depositors	3,000	5,848	5,674

Principal Crops.

The principal crops are fruits, grain, forage, and vegetables. Of the vegetables potatoes rank first, although cabbage, asparagus, tomatoes, eggplant, onions, and other garden products are being planted in increasing quantities.

Alfalfa hay is the largest crop in acreage grown and in gross value of returns to the grower. The backward and cool spring, combined with early cutting because of cheat, caused the first cutting to be lighter than normal. The second cutting was good, both in quality and quantity, while the third was below normal because of water shortage. The average yield for the season was 4 tons per acre as compared with 5 tons in 1914. The total acreage was slightly less than in 1914. Some old fields were plowed under and planted to corn and potatoes and the water shortage prevented nearly all new seeding. The area planted to timothy and clover shows a marked decrease. The average yield of 3 tons per acre is less than normal, though the average price realized is better. The area in pasture increased 33 per cent as compared with 1914.

The gross value of the 1915 crop was $2,750,326, as compared to $2,858,845 in 1914 and $2,820,786 in 1913. The low prices for soft fruits and light apple crop combined with the low average yield of hay explains this decrease. The average gross return per acre is $50.08 as compared with $58.02 in 1914, and $61 in 1913. An interesting showing is made by dividing the crop into two classes, fruit, and forage and vegetables, and then comparing the gross returns for the years 1914 and 1915. The gross returns for fruit of all kinds constitute 39.5 per cent of the total in 1914 and 27 per cent in 1915. Potatoes, corn fodder, and garden crops show higher average yields than apples. It would appear that hundreds of acres of apples planted on land not adapted to that production should be grubbed out and the land devoted to more profitable uses.

At first sight the reduction in gross total and average returns appears discouraging, but on further analysis it appears that the actual conditions are better than might be inferred from the gross returns. This year's apple crop, while only one-third the total yield of the previous year, was sold at an average price of $0.021 per pound, which nets the grower practically 50 cents per box. The same is true of the hay and potato crops, both of which show a splendid margin of profit at the 1915 prices, while the prices for the previous year barely covered the cost of production.

The acreage planted to potatoes shows an increase of 198 acres as compared with 1914, with a yield averaging somewhat less and a price materially better, giving a gross return of 23 per cent in excess of that received in 1914. Corn shows the greatest increase in acreage and gross return. The average yield was exceptionally good. The water shortage affected the corn only slightly, and the very warm August was the making of the crop. The acreage in corn increased 36 per cent as compared with 1914 and 81 per cent as compared with 1913; the gross return increased 58 per cent as compared with 1914. A marked increase is noted in the acreage in garden. This is accounted for largely in the increased acreage devoted to melons, squash, and tomatoes.

The average yield of soft fruits was less than in 1914, although the returns were about the same, peaches bringing an average of 25 cents a box and pears 80 cents a box. Apples showed a marked improvement in price, with a yield of about one-third that in 1914. A slight increase in acreage of bearing orchard is noted, but is more than offset by the decrease of young orchard area. While the average return per acre from apples is shown as $47, the fact is that some growers had heavy crops and at the prevailing prices realized excellent returns, in cases reaching as high as $300 per acre, net, while many hundreds of acres of old orchard produced no crop whatever, and the crop generally was very light. The poor prices which have prevailed for apples during the past three or four years and the lack of any comprehensive marketing system have made the outlook for the apple men extremely dubious. The thrifty ones are introducing side lines of hogs and dairy cattle, and those whose orchards are, by reason of location, variety, or other conditions, less profitable than the average are in many cases uprooting the trees.

Crop report, Sunnyside unit, Yakima project, Washington, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa hay	26,042	Tons	104,168	4.0	$9.00	$937,512	$36.00
Apples	8,564	Pounds	19,269,000	2,250.0	.021	404,649	47.25
Barley	312	Bushels	9,865	31.6	.65	6,412	20.54
Clover hay	293	Tons	879	3.0	10.00	8,790	30.00
Corn	8,165	Bushels	489,900	60.0	.60	293,940	36.00
Corn fodder	1,032	Tons	11,352	11.0	6.00	68,112	66.00
Small fruit	464					64,960	140.00
Garden	1,349					134,900	100.00
Hay, except above	839	Tons	2,517	3.0	9.00	22,653	27.00
Hops	170	Pounds	408,000	2,400.0	.11	44,880	264.00
Oats	207	Bushels	12,420	60.0	.45	5,589	27.00
Pasture	3,326					66,520	20.00
Peaches	1,059	Pounds	6,235,320	5,900.0	.0125	77,942	73.60
Pears	1,144	...do	8,084,600	7,067.0	.016	129,353	113.07
Prunes	206	...do	2,619,440	12,230.0	.024	62,869	305.13
Potatoes	4,025	Bushels	872,300	217.0	.45	392,535	97.50
Wheat	1,595	...do	31,900	20.0	.90	28,710	18.00
Less duplicated areas	3,873						
Total cropped acreage.	54,919	Total and average				2,750,326	50.08

Crop.	Area (acres).	Areas.	Acres.	Farms.	Per cent of project.
Irrigated, no crop:		Total irrigable area farms reported	68,840	2,553	62.11
Young orchard	6,108	Total irrigated area farms reported	66,607	2,553	60.10
Young alfalfa	777	Under water-right applications	25,400	899	22.92
Miscellaneous	3,284	Under rental contracts	41,207	1,654	37.18
Town and building sites	4,891	Total cropped area farms reported	54,919	2,553	49.55
Less duplicated areas	3,372				
Total irrigated acreage.	66,607				

TIETON UNIT.

History of Construction and Engineering Features.

During the year 1905 the feasibility of the Tieton unit was investigated and following this investigation the original allotment for the construction of the Tieton unit of the Yakima project was approved by the Secretary of the Interior on March 27, 1906. The Tieton Canal system is designed to furnish water for the irrigation of 34,500 acres of land and involves the construction of a regulating reservoir, a diversion dam and headworks, main canal, and distribution system.

CLEAR CREEK DAM.

The regulating reservoir, created by the Clear Creek Dam, is located just below the mouth of Clear Creek on the North Fork of the Tieton River, about 15 miles from the summit of the Cascades and 15 miles above the diversion works for the Tieton Canal. The purpose of the reservoir is to equalize the diurnal flow of the Tieton River during the summer months of July and August. Investigations were carried on at the site of the dam during the fall of 1913 and construction work on the dam was begun in April, 1914. The work was all done by Government forces and the dam was completed in November, 1914. It is built of reinforced concrete and is of a single arch variable radius type, ultimate height 78 feet, height for first development 35 feet; storage under first development 1,700 acre-feet, and final development 7,000 acre-feet; thickness at the base 10 feet 3 inches, radius at the top 128 feet, radius at the bottom 134 feet, 8½ inches.

The outlet works consist of two 36-inch pipes through the dam with the usual gates and operating devices. Provision will be made for a short spillway in the final development. The present spill, however, is over the crest.

DIVERSION DAM AND HEADWORKS.

The diversion dam for the Tieton unit is located on the Tieton River approximately 15 miles above its junction with the Naches River, approximately 8 miles below the McAllister Dam site, and 15 miles below the Clear Creek regulating reservoir. The diversion dam is a concrete weir 3 feet high and 110 feet long. At the end of the dam on the right side of the river is located the headworks structure of the Main Canal. This structure is built of reinforced concrete and contains three 4 by 5 foot gate openings, each controlled by a cast-iron sluice gate operated by hand. On the left side of the river the dam terminates in a low retaining wall, with a top elevation 5 feet above the weir crest. Sloping from this wall to an elevation 7 feet greater is the paved face of an earth embankment which extends to high ground, a distance of 400 feet. This embankment has an average height of about 3 feet, a top width of 8 feet, and side slopes of 3 to 1. About midway is a relief spillway 50 feet long protected by a heavy paving of bowlders. The diversion dam and headworks were constructed by Government forces. The work was begun in June, 1908, and completed in December of the same year.

TIETON MAIN CANAL.

The Main Canal of the Tieton unit is located along the very steep and precipitous south side of the Tieton Canyon beginning at the headgates and continuing 12 miles down the canyon, at which point it attains a height of 500 feet above the river and passes through the rim of the canyon by way of a tunnel to the project lands below. The Main Canal has a capacity of 300 second-feet and consists of approximately 10 miles of open canal and 2 miles of tunnels; with the exception of 16 stations below the headgates and a short section in the deep portal cut below the last tunnel the Main Canal is concrete lined throughout.

The open canal excavation was executed by Government forces; work was begun in May, 1907, and completed in August, 1908. The tunnel work was done by Government forces, except one informal contract for one 1,200-foot tunnel. The work was begun in February, 1907, and was completed in October, 1908.

The concrete lining for the Main Canal was constructed in two-foot sections at convenient locations, transported to the canal, and set in place. The entire Main Canal was lined with the concrete shapes except Trail Creek Tunnel, which was lined with a monolithic concrete lining, as there was no convenient yard to mold shapes and as it was possible to do the work during the winter. A contract was entered into for the entire concrete lining in January, 1907, and work was begun in March, 1907. In February, 1908, the contract was suspended on account of unsatisfactory progress, and the work was then undertaken by Government forces; the manufacture and placing of the shapes were completed in October, 1909.

The structures in connection with the Main Canal consist of 1 combined transition, spillway, and sand box, 5 automatic wasteways equipped with electrical signals, 8 transitions at inlets and outlets of principal tunnels, 20 culverts, 64 rock walls and dry stone fills, 24 overhead flumes, and 103 drain tile outlets. These were all constructed by Government forces and were all done during 1908 and 1909. The five wasteways consist of the ordinary sluice gates operated by a turbine. These wasteways are electrically connected by automatic alarms which are operated by floats located along the entire length of the canal at a distance of 250 feet apart. These consist of both high-water floats which are set at the safety of the canal, and low-water floats, which are adjusted according to the amount of water being carried.

DISTRIBUTION SYSTEM.

The distribution system consists of three separate units, covering approximately 12,000 acres each—namely, the Naches branch, watering lands lying between the Naches River and the North Fork of the Cowiche Creek; the Cowiche-Yakima branch, watering lands lying in Cowiche Valley and the Yakima Ridge; and the Wide Hollow branch, watering the lands between the Cowiche Mountain and Ahtanum Creek. The distribution system to irrigate these lands consists of the following ditches and structures: Four miles of the natural channel of the North Fork of the Cowiche Creek; 5 rubble masonry diversion dams; 92 miles of main laterals, which consist of 0.23 mile of wood pipe, 0.17 mile of concrete pipe, 0.59 mile of wood flume, 1.83 miles of metal flume, and 89.18 miles of open laterals, and 231 miles of sublaterals, consisting of 5.34 miles of wood pipe, 46.44 miles of concrete pipe, 12.27 miles of wood flume, and 166.95 miles of open ditch.

A contract for the construction of the main laterals of the Naches branch was entered into in September, 1909. Work was begun in October. The sublaterals and all structures were built by Government forces, and all work was completed in June, 1910. Water was delivered on a rental basis to about 1,600 acres on this branch during 1910.

A contract was entered into in April, 1910, for the construction of the main laterals of the Cowiche-Yakima branch. As on the Naches branch, the sublaterals and structures were built by Government forces, and the work was all completed in the fall of 1910. During this season the permanent headquarters and other patrol houses necessary for the operation and maintenance of the project were built, together with 68 miles of telephone line.

A contract was entered into in the fall of 1910 for the excavation of both the main and sublaterals of the Wide Hollow branch, and the work was begun in December. The structures were all built by Government forces during the summer of 1911.

Other construction work since the completion of the project has consisted of the building of 2½ miles of wagon road, connecting the county road in the north fork of the Cowiche with the Tieton Canyon

Road, done under contract during the summer of 1912. This road makes a direct connection between the project headquarters and the Tieton Main Canal.

Construction During Fiscal Year.

Bumping Lake.—The only work in connection with the completion of the Bumping Lake Dam and Reservoir as originally planned which remained to be done during the fiscal year 1916 was the final cleaning up of the clearing operations on the extreme upper end of the lake. This work consisted of the piling and burning of the remaining brush and logs and was all completed by Government forces in the fall of 1915.

Operation and Maintenance.

The total amount of land being irrigated at the end of the fiscal year 1916 is 23,600 acres. This represents over 70 per cent of the irrigable land under the project. Water is delivered on a strict rotation basis over the entire project to approximately 10,000 acres on a schedule of 7 days on and 7 days off and to the remaining area on a schedule of 7 days on and 14 days off. The deliveries are in general made at the rate of 1 second-foot to 140 acres continuous flow. A standard delivery for the above period on hay land is 1 second-foot. The above rotation schedules have been in force two seasons and have proven satisfactory.

The season of 1915 was marked by an exceedingly low runoff of all the streams and the use of water was limited during the latter months. No serious interruptions were caused by storms or canal breaks and the entire system was operated successfully throughout the season.

Maintenance work consisted of the cleaning and repairing of main laterals in the distribution system and the raising of the sides of 500 feet of the Main Canal. This was the first season the Clear Creek regulating reservoir was operated, and owing to the extremely dry year the maximum benefit from this reservoir was derived.

Historical Review, Tieton unit, Yakima project.

Item.	1911	1912	1913	1914	1915	1916[1]
Acreage for which service was prepared to supply water	19,378	34,000	34,000	34,000	28,000	33,520
Acreage irrigated	7,115	15,000	18,750	20,600	22,000	24,000
Miles of canal operated	166	260	335	335	335	335
Water diverted (acre-feet)	22,698	47,675	59,500	67,790	62,000	69,000
Water served to land (acre-feet)	13,733	34,445	42,539	43,099	40,376	48,000
Per cent of land irrigated (acre-feet)	1.91	2.27	2.27	2.09	1.83	2.00

[1] 1916 estimated.

Settlement.

The general development on the Tieton unit during the past year has shown more than an average increase. There is a marked increase in settlers, in building activities, and in the farming and stock industries. New telephone lines have been built and many new roads have been constructed. Crops have been disposed of at a good price, the land is becoming more productive, and the farmers are becoming more prosperous.

Settlement data, Tieton unit, Yakima project.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	875	900	1,000	1,200	1,300
Population	1,174	1,622	1,916	2,500	2,800
Number of irrigated farms	875	900	1,000	1,200	1,300
Population	1,174	1,622	1,916	2,500	2,800
Number of towns (on and adjacent to project)	7	7	7	7	7
Population	14,000	15,300	18,000	20,000	21,000
Total population in towns and on farms	15,174	16,922	19,916	22,500	23,800
Number of public schools	6	9	10	10	10
Number of churches[1]	3	3	3	3	3

[1] Not including schoolhouses at which services are held.

Principal Crops.

The principal crops at present are alfalfa hay, wheat, oats, and potatoes. The main crops comprise all kinds of hay, grain, and vegetables, including hops and small fruits.

The 1915 crop report given below shows very profitable returns.

Crop report, Tieton unit, Yakima project, Washington, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa hay	6,740	Tons	23,300	3.5	$7.50	$174,750	$26
Apples	1,550	Pounds	3,878,000	2,500.0	.03	116,340	75
Barley	600	Bushels	26,000	44.0	.60	15,600	26
Beans	80	...do	1,275	16.0	2.40	3,060	38
Beets, sugar	1	Tons	10	10.0	10.00	100	100
Clover hay	485	...do	970	2.0	6.00	5,820	12
Clover seed	84	Bushels	251	3.0	10.00	2,510	30
Corn, Indian	1,350	...do	43,280	32.0	.75	32,460	24
Corn, broom	12	Pounds	6,000	500.0	.05	300	25
Corn fodder	100	Tons	800	8.0	3.00	2,400	24
Carrots	10	...do	110	11.0	8.00	880	88
Fruits, small	30	Pounds	81,000	2,700.0	.05	4,050	135
Garden	250					15,000	60
Hay, other	620	Tons	1,085	2.0	8.00	8,680	14
Hops	375	Pounds	573,200	1,530.0	.10	57,320	153
Oats	700	Bushels	31,600	45.0	.40	12,640	18
Onions	50	...do	4,500	90.0	.50	2,250	45
Pasture	820					12,300	15
Peaches	375	Pounds	2,069,000	5,500.0	.01	20,690	55
Pears	310	...do	441,500	1,420	.02	8,830	28
Peas	1	Bushels	10	10	3.00	30	30
Prunes	3	Pounds	6,000	2,000	.04	240	80
Potatoes	2,200	Bushels	301,800	140	.40	120,720	55
Turnips	5	Tons	60	12	5.00	300	60
Sunflowers	14	Pounds	10,500	750	.04	420	30
Wheat	2,560	Bushels	63,700	25	.80	50,960	20
Less duplicated areas	1,225						
Total cropped acreage	18,100	Total and average				668,650	37

Crop.	Area (acres).
Irrigated, no crop:	
Nonbearing orchards	5,840
Ground fall plowing	150
Young alfalfa	780
Miscellaneous	350
Less duplicated areas	3,220
Total irrigated acreage	22,000

Areas.	Acres.	Farms.	Per cent of project.
Total irrigable area farms reported	24,900	995	74.5
Total irrigated area farms reported:			
Under water-right applications	22,000	995	66.0
Total cropped area farms reported	18,100	900	54.0

ECONOMIES OF GOVERNMENT WORK.

The larger features of the Yakima project have been constructed by Government forces. This has been due to two causes—first, failure on the part of contractors on the principal features let by contract to make satisfactory progress, necessitating the suspension of contracts and completion of work by the Government; second, various uncertainties in connection with the work, on account of the necessity of maintaining service through the canals during the time of construction. It is therefore difficult to furnish comparative cost data which would be of any value. Excavation on some portions of the distribution system has been handled economically by contract, but, on the other hand, some sections of very similar work have been done at a lesser unit cost, all things considered, by Government forces.

It is interesting to note, however, the economy resulting in a larger way from the permanent type of construction, which has in the main characterized the activities of the work of the Government on this project. The Sunnyside unit has now been operated by the Reclamation Service for 10 years, and the Tieton unit for over 5 years, and it appears that the annual maintenance charge necessary to maintain these two systems in a condition equal to that when new will be about $1 per acre and $1.35 per acre, respectively. At these rates it is believed that the systems can be maintained indefinitely without special levies for reconstruction of any portion of the system maintained by the Government.

Under private canals in the Yakima Valley, where all conditions are fully as favorable as for the Government project, the original construction cost of which varied from $40 to $75 per acre, it has been found necessary within the past two years to reconstruct to a very large extent the main features of the canal systems, and two or three of the larger canals in the valley have made expenditures for reconstruction which, including interest, will cost the landowners from $50 to nearly $100 per acre. In other words, the cheaply constructed private projects are now paying out for reconstruction more than the entire first cost per acre of the Tieton and Sunnyside units of the Yakima project.

As to operation and maintenance costs, no private project in the Yakima Valley is giving service value for the charge imposed equal to that under the Government project. Under private projects the almost universal practice is to deliver water at the bank of the main canal, at which point all obligations of the management cease. Under the Government project, distributaries have been built to each farm unit, and the water is actually delivered by Government employees to every landowner.

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, JULY 27, 1915.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplementary thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given

that water is available from the Sunnyside unit in the irrigation season of 1915 and thereafter upon the filing of proper water-right application, for the irrigable lands shown on the following amended farm-unit plats: Willamette meridian, T. 8 N., Rs. 22, 23, 24, and 25; T. 9 N., Rs. 22, 23, 24, and 25; T. 10 N., Rs. 21, 22, and 23; T. 11 N., Rs. 19, 20, and 21; approved by the Secretary of the Interior on June 23, 1915, and on file in the office of the project manager, United States Reclamation Service, and local land office at North Yakima, Wash.

2. A supplemental list showing all changes in the irrigable areas heretofore opened to irrigation, as well as the lands now open to water-right application and irrigation, has been filed in the project office at Sunnyside, Wash.

3. Water-right application for lands in private ownership may be made to the project manager, North Yakima, Wash., on and after the date of this notice. The limit of area for which water-right application may be made for lands in private ownership is fixed at 160 acres of irrigable land for each landowner.

4. The water-right charges for the said lands shall be of two kinds: (*a*) Charge of $52 per irrigable acre for the building of the irrigation system termed the "construction charge," the installments being due and payable as hereinafter provided; and (*b*) an annual charge for operation and maintenance due and payable March 1 of each year for the preceding irrigation season. The operation and maintenance charge for the irrigation season of 1915 shall be due on March 1, 1916, and shall be of the amounts and terms of payment provided in public notice of March 31, 1915, for said Sunnyside unit.

5. For all said lands for which public notice has not been heretofore issued, but which were on or before August 13, 1914, subject to the terms and conditions of the reclamation law, and for which water-right applications under the terms of the reclamation extension act shall be duly filed within six months from the date hereof, the first installment of the construction charge shall be due on December 1, 1915, and subsequent installments on December 1 of each year thereafter. The first 4 of such installments shall each be 2 per cent, the next 2 each 4 per cent, and the next 14 each 6 per cent of the construction charge.

6. For any landholder described in paragraph 5 who elects not to file acceptance by means of application under the reclamation extension act within the time limited by law, the first installment shall be due December 1, 1915, and the same shall consist of one-tenth of the construction charge, namely $5.20 per irrigable acre, and payment shall be made on account of operation and maintenance as provided in paragraph 4 hereof. Additional installments, each one-tenth of the construction charge, shall be due on December 1 of each year thereafter for nine years. Persons coming under the terms of this paragraph shall file water-right application on the form in use prior to the passage of the act of August 13, 1914.

7. For all lands which were not, on or before August 13, 1914, subject to the terms and conditions of the reclamation law, a payment of $2.60 per irrigable acre on account of the construction charge, called the initial payment, must be made at the time of making water-right application. The remainder of the construction

charge, to wit, $49.40 per irrigable acre, must be paid in 15 annual installments, the first 5 of which shall be $2.60 each and the remaining installments $3.64 each per irrigable acre. The first annual installment becomes due December 1 of the fifth calendar year after the year in which the initial installment is due. The subsequent annual installments become due December 1 of each year thereafter until fully paid.

8. For land described on said farm unit plats which is included in a water-right application heretofore filed the construction charge for the irrigable area added by the aforesaid list shall be payable in the same number of installments and in the same amounts per installment as the remainder of the lands included in the water-right application. The first of such installments shall become due on the same day as the first installment which becomes due hereafter for the other lands included in such water-right application, and subsequent installments on the same day of each year thereafter until fully paid.

9. In all cases where water-right application for lands in private ownership or for lands held under entries not subject to said reclamation act shall not be made within one year from date of this notice, the construction charge for such land shall be increased 5 per cent each year until water-right application and an initial payment are made.

10. The lands hereby opened to irrigation shall be subject, so far as applicable, to the public notices and orders heretofore issued for lands under the Sunnyside unit.

11. Any water-right applicant may pay the whole or any part of the construction charge within a shorter period.

12. The method of determining the annual operation and maintenance charge, and the penalties for failure to pay the construction charge and the operation and maintenance charges when due and discount allowed for prepayment of operation and maintenance charges will be as provided by the act of August 13, 1914 (38 Stat., 686).

A. A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, OCTOBER 30, 1915.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplementary thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water is available from the Tieton unit for the irrigation season of 1916 and thereafter upon the filing of proper water-right application for the following irrigable lands shown on amended farm-unit plat of T. 14 N., R. 17 E., W. M.:

Areas hereby opened to irrigation:

T. 14 N., R. 17 E., W. M.—	Acres.
Sec. 15, NW. ¼ SW. ¼	10
Sec. 22, NE. ¼ NW. ¼	32
Sec. 22, SW. ¼ NW. ¼	12
Sec. 22, NW. ¼ NE. ¼	2
Sec. 22, NW. ¼ NW. ¼	18
Sec. 22, SE. ¼ NW. ¼	6

The said plat is on file in the office of the project manager, United States Reclamation Service, North Yakima, Wash.

2. Water-right applications for said lands may be made to the project manager, North Yakima, Wash., on and after the date of this notice. The limit of area for which water-right application may be made for lands in private ownership is fixed at 160 acres of irrigable land for each landowner.

3. The water-right charges for the said lands shall be of two kinds: (*a*) A charge of $93 per irrigable acre for the building of the irrigation system, termed the "construction charge," the installments being due and payable as hereinafter provided; and (*b*) an annual charge for operation and maintenance due and payable March 1 of each year for the preceding irrigation season. The operation and maintenance charge for the irrigation season of 1916, and each year thereafter until further notice, shall be in the amounts and according to the terms of payment prescribed in public notice of March 19, 1915, for the said Tieton unit.

4. All the lands above described had, prior to August 13, 1914, become subject to the reclamation law, and are therefore subject to the provisions of section 2 of the reclamation extension act of that date. The construction charge shall be due and payable in 20 annual installments, the first 4 of which shall each be 2 per cent, the next 2 each 4 per cent, and the next 14 6 per cent of the construction charge. The first installment shall be due and payable on December 1, 1915, and the subsequent installments on December 1 of each year thereafter until fully paid.

5. The terms of payment as herein specified are subject to the provision that in all cases where water-right application shall not be made within one year from the date hereof, the said construction charge shall be increased 5 per cent each year until water-right application has been filed and an initial payment made, and shall be subject to the further provision that for any landowner who elects not to file acceptance under the said reclamation extension act within six months from the date hereof, the said construction charges shall be paid in 10 equal annual installments, each of which shall be not less than one-tenth of the said construction charge.

6. Any water-right applicant may pay the whole or any part of the construction charge within a shorter period.

7. All charges must be paid at the office of the United States Reclamation Service at Denver, Colo. Drafts on New York or Denver, money orders, etc., should be made payable to the disbursing officer, United States Reclamation Service, Denver, Colo.

8. The lands hereby opened to irrigation shall be subject, so far as applicable, to the public notices and orders heretofore issued for lands under the Sunnyside unit.

9. The lands made subject to water-right applications hereunder are above gravity flow from the system of the said Tieton unit, and water-right applicants must assume all responsibility for raising water from said system to the land to be irrigated, which responsibility shall not, however, affect the charges to be paid to the United States for water rights under the said unit.

10. The method of determining the annual operation and maintenance charge, and the penalties for failure to pay the construction

charge and the operation and maintenance charges when due, and discount allowed for prepayment of operation and maintenance charges will be as provided by the act of August 13, 1914 (38 Stat., 686).

FRANKLIN K. LANE,
Secretary of the Interior.

PUBLIC NOTICE, APRIL 3, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388) and acts amendatory thereof and supplemental thereto, and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, notice is hereby given that hereafter, until further notice, for all lands under the Tieton unit, Yakima project, Washington, the operation and maintenance charge for any irrigation season shall be due and payable on March 1 of the following calendar year.

2. The operation and maintenance charges for the irrigation season of 1916, and for each irrigation season thereafter until further notice, shall be due on March 1 of the following year, and each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of $1, which will permit delivery of not more than 1 acre-foot per acre; for the first acre-foot per acre additional the charge shall be at the rate of 50 cents per acre-foot, and should further quantities be needed they will be furnished at the rate of 75 cents per acre-foot.

3. The provisions of this public notice cover all lands subject to public notice heretofore issued for the said project.

4. Except as hereinabove provided, all the terms and provisions of existing public notices and orders, and in particular the public notice of March 19, 1915, for the Tieton unit, shall remain unchanged.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, APRIL 6, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, public notice was given on March 31, 1915, that for all lands under the Sunnyside unit, Yakima project, Washington, the operation and maintenance charge for any irrigation season shall be due and payable on March 1 of the following calendar year.

2. For the season of 1916, each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of 80 cents, which will permit delivery of not more than 2 acre-feet per acre; for the first acre-foot per acre additional the charge shall be at the rate of 25 cents per acre-foot, for the second acre-foot per acre additional at the rate of 60 cents per acre-foot, should further quantities be needed they will be furnished

at the rate of 80 cents per acre-foot: *Provided*, That the quantity of water delivered for the minimum charge may be increased where it is found by the unanimous report of a committee of three competent and impartial persons appointed by the water users' association that the irrigator has used all reasonable means of economizing water, and from the nature of the soil it is impracticable to properly irrigate the land with a less quantity of water than that used by the irrigator. In no case, however, shall such a report decrease the charge to a smaller amount than $1 per acre nor be effective until approved by the project manager.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

PUBLIC NOTICE, MAY 31, 1916.

1. In pursuance of the provisions of section 4 of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplementary thereto, and particularly the reclamation extension act of August 13, 1914 (38 Stat., 686), notice is hereby given that water is available from the Sunnyside unit in the irrigation season of 1916 and thereafter upon the filing of proper water-right application, for the irrigable lands shown on the list of the following lands: Willamette meridian, T. 8 N., Rs. 22, 23, and 24 E.; T. 9 N., Rs. 22, 23, 24, and 25 E.; T. 10 N., Rs. 22 and 23 E.; T. 11 N., R. 20 E., approved under authority of this department by the Director and chief engineer of the Reclamation Service on May 31, 1916, and a copy of which list is on file in the office of the project manager, United States Reclamation Service, and in the local land office at North Yakima, Wash. A portion of the lands made subject to water-right applications hereunder are above gravity flow from the system of the said Sunnyside unit, and water-rights applicants must assume all responsibility for raising water from said system to the land to be irrigated, which responsibility shall not, however, affect the charges to be paid to the United States for water rights under the said unit. Said list shows all changes in the irrigable areas heretofore opened to irrigation as well as the land opened to water-right application and irrigation under this public notice.

2. Water-right application for lands in private ownership may be made to the project manager, North Yakima, Wash., on and after the date of this notice. The limit of area for which water-right application may be made for lands in private ownership is fixed at 160 acres of irrigable land for each land owner.

3. The water-right charges for the said lands shall be of two kinds: (*a*) A charge of $52 per irrigable acre for the building of the irrigation system termed the construction charge, the installments being due and payable as hereinafter provided; and (*b*) an annual charge for operation and maintenance due and payable March 1 of each year for the preceding irrigation season. The operation and maintenance charge for the irrigation season of 1916 shall be due on March 1, 1917, and shall be of the amounts and terms of payment provided in public notice of April 18, 1916, for said Sunnyside unit.

4. For all said lands for which public notice has not been heretofore issued, but which were on or before August 13, 1914, subject to the terms and conditions of the reclamation law, and for which water-right application or acceptance under the terms of the reclamation extension act shall be duly filed within six months from the date hereof, the first installment of the construction charge shall be due on December 1, 1916, and subsequent installments on December 1 of each year thereafter. The first 4 of such installments shall each be 2 per cent, the next 2 each 4 per cent, and the next 14 each 6 per cent of the construction charge.

5. For any landholder described in paragraph 4 who elects not to file acceptance under the reclamation extension act within the time limited by law, the first installment shall be due December 1, 1916, and the same shall consist of one-tenth of the construction charge, namely, $5.20 per irrigable acre, and payment shall be made on account of operation and maintenance as provided in paragraph 3 hereof. Additional installments, each one-tenth of the construction charge, shall be due on December 1 of each year thereafter for nine years. Persons coming under the terms of this paragraph shall file water-right application on the form in use prior to the passage of the act of August 13, 1914.

6. For all lands on said list which were not, on or before August 13, 1914, subject to the terms and conditions of the reclamation law, a payment of $2.60 per irrigable acre on account of the construction charge, called the initial payment, must be made at the time of making water-right application. The remainder of the construction charge, to wit, $49.40 per irrigable acre, must be paid in 15 annual installments, the first 5 of which shall be $2.60 each and the remaining installments $3.64 each per irrigable acre. The first annual installment becomes due December 1 of the fifth calendar year after the year in which the initial installment is due. The subsequent annual installments become due December 1 of each year thereafter until fully paid.

7. For land described on said list which is included in a water-right application heretofore filed the construction charge for the irrigable area added by the aforesaid list shall be payable in the same number of installments and in the same amounts per installment as the remainder of the lands included in the water-right application. The first of such installments shall become due on the same day as the first installment which becomes due hereafter for the other lands included in such water-right application and subsequent installments on the same day of each year thereafter until fully paid.

8. In all cases where water-right application for lands in private ownership or for lands held under entries not subject to said reclamation act shall not be made within one year from date of this notice, the construction charge for such land shall be increased 5 per cent each year until water-right application and an initial payment are made.

9. The lands hereby opened to irrigation shall be subject, so far as applicable, to the public notices and orders heretofore issued for lands under the Sunnyside unit.

10. Any water-right applicant may pay the whole or any part of the construction charge within a shorter period.

11. The method of determining the annual operation and maintenance charge, and the penalties for failure to pay the construction charge and the operation and maintenance charges when due and discount allowed for prepayment of operation and maintenance charges, will be as provided by the act of August 13, 1914 (38 Stat., 686).

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 739.]

Feature costs of the Yakima-storage unit to June 30, 1916.

Features.	Sub-feature.	Principal features.
Examination and surveys:		
Clealum	$33,141.56	
Tieton Reservoir	20,564.98	
Reservoir reconnoissance	2,927.92	
Hydrographic survey	5,460.48	
Hydrographic investment	29,303.43	
High line	2,700.12	$94,098.49
Storage system:		
Preliminary and general work—		
Kachess	20,778.13	
Keechelus	117,564.53	
Clealum	104,736.14	
Dams—		
Kachess	427,112.94	
Keechelus	976,192.53	
Spillways—		
Kachess	35,625.63	
Keechelus	41,874.17	
Tunnel, Keechelus	119,236.01	
Clearing and logging reservoir area—		
Kachess	188,611.27	
Keechelus	7,984.95	2,039,716.30
Permanent improvements and lands:		
Buildings—		
Kachess	2,667.90	
Keechelus	2,553.39	
Roads—		
Keechelus	13,211.35	
Tieton Reservoir	17,049.13	35,481.57
Telephone system, telephone lines:		
Kachess	1,008.07	
Keechelus	2,429.58	3,437.65
Operation and maintenance during construction (water-rental basis)		8,307.84
Plant accounts		61,542.39
Gross cost of construction of project to June 30, 1916		2,242,584.24
Less revenues earned during construction period:		
Rental of buildings	21,346.92	
Rental of grazing and farming lands	51.00	
Rentals, power, and light	1,385.47	
Rentals of irrigation water	14,305.00	
Rentals of telephone and tolls	22.80	
Other revenues, unclassified	40,454.95	
Profit on mess-house operations	41,063.88	
Profit on mercantile store operations	12,663.63	
Profit on hospital operations	1,306.94	132,600.59
Net cost of construction of project to June 30, 1916		2,109,983.65

Estimated cost of contemplated work, Yakima storage unit, during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examination and surveys, consisting of test pits, borings, and surveys, at Clealum or Tieton Reservoirs		$4,000.00
Storage works:		
Dam	$252,500.00	
Spillway	55,500.00	
Bridges (permanent foot bridge)	6,000.00	
Clearing reservoir site	106,000.00	
		420,000.00
Permanent improvements and land:		
Land and timber on reservoir area, Keechelus, Kachess, and Clealum	35,000.00	
Roads	2,000.00	
Land and timber, construction of Keechelus Dam	2,600.00	
Bridges, highway	4,250.00	
		43,850.00
Telephone system, telephone lines		800.00
Operation and maintenance, public notice		14,000.00
Messes		4,000.00
Stores		3,000.00
Hospitals		3,000.00
Total		492,650.00

Feature costs of Yakima-Sunnyside unit, to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys		$46,090.19
Pumping for irrigation:		
Preliminary and general work	$9,496.77	
Wells, pits, and shafts	1,354.65	
Pumping plants	123,710.41	
Administrative general expense	3,225.76	
		137,787.59
Canal system:		
Preliminary and general work	478.63	
Diversion dam and headworks	56,610.81	
Main Canal	1,623,579.12	
Administrative general expense	943.66	
Supplemental construction cost	2,606.40	
		1,684,218.62
Lateral system:		
Preliminary and general work	17,328.64	
Laterals and sublaterals	599,302.83	
Flume	28,530.07	
Drops, chutes, and checks	40,326.48	
Siphons	268,095.16	
		953,583.18
Drainage system		11,418.80
Farm units		22,012.91
Permanent improvements and lands:		
Headquarters, buildings, and grounds	24,276.46	
Patrol houses and grounds	11,852.09	
		36,128.55
Telephone system		22,412.57
Operation and maintenance during construction		7,584.70
Plant accounts		8,967.20
Operation and maintenance charges transferred to and compounded with construction charges		10,714.25
Gross cost of construction of project to June 30, 1916		2,940,918.56
Less revenues earned during construction period:		
Rental of buildings	3,260.67	
Contractors' freight refunds	10,158.12	
Forfeitures by defaulting bidders and contractors	5,391.16	
Profit on mess-house operations	3,768.01	
Profit on mercantile store operations	2,917.75	
Profit on hospital operations	974.98	
		26,470.69
Net cost of construction of project to June 30, 1916		2,914,447.87

Estimated cost of contemplated work, Yakima-Sunnyside unit, during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examination and survey, preliminary and general work		$2,000.00
Pumping for irrigation:		
Preliminary for general work	6,000.00	
Pumping plants	71,200.00	
Transmission lines	5,000.00	
Pipe lines	32,500.00	
		114,700.00
Canal system, main canal		8,700.00
Lateral system:		
Preliminary and general work	6,000.00	
Laterals and sublaterals	60,050.00	
Flumes	9,500.00	
Pipe lines	23,750.00	
Drops, checks, and deliveries	10,900.00	
Culverts and turnouts	2,800.00	
		113,000.00
Farm units, survey and office work		2,500.00
Operation and maintenance during construction		14,000.00
Operation and maintenance under public notice		96,700.00
Messes		800.00
Mercantile stores		100.00
Hospital		300.00
Total		352,800.00

Feature costs of Yakima-Tieton unit, to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and survey		$69,694.56
Storage works:		
Bumping Lake Dam	$550,837.42	
Clear Creek Dam	84,542.78	
		635,380.20
Canal system:		
Headworks	14,937.15	
Tunnels	397,100.73	
Main Canal	641,742.54	
Wasteways	57,181.22	
Culverts and drains	22,453.97	
		1,133,415.61
Lateral system:		
Headworks and diversion dams	26,958.20	
Laterals and sublaterals	864,724.01	
Flumes	108,390.45	
Bridges	5,562.36	
Drops, chutes, checks, and turnouts	77,442.46	
Siphons	14,175.95	
Wasteways	11,067.21	
Culverts and drains	54,226.07	
		1,162,546.71
Permanent improvement and lands:		
Buildings and grounds	41,943.95	
Roads	59,573.55	
Real estate	2,768.60	
		104,286.10
Telephone system, telephone lines		25,148.78
Operation and maintenance during construction		10,208.54
Operation and maintenance charges transferred to and compounded with construction charges		28,950.97
Gross cost of construction of project to June 30, 1916		3,169,631.47
Less revenues earned during construction period:		
Rental of buildings	4,827.35	
Rental of irrigation water	3,526.50	
Contractors' freight refunds	5,092.12	
Mess-house loss	[1] 1,131.79	
Mercantile store gain	9,992.83	
Hospital gain	2,185.94	
		24,492.95
Net cost of construction of project to June 30, 1916		3,145,138.52

[1] Deduct.

Estimated cost of contemplated work, Yakima-Tieton unit, during fiscal year 1917.

Features.	Sub-feature.	Principal feature.
Canal system, Main Canal		$38,000.00
Operation and maintenance under public notice		42,000.00
Messes		400.00
Mercantile stores		200.00
Hospitals		200.00
Total		80,800.00

WYOMING, SHOSHONE PROJECT.

G. O. **Sanford**, project manager, Powell, Wyo.

LOCATION.

Counties: Park and Big Horn.

Townships, 52 to 58 N., Rs. 97 to 104 W., sixth principal meridian.

Railroad: Chicago, Burlington & Quincy.

Railroad stations and estimated population January 1, 1916: Cody, 1,300; [1] Corbett; Deaver, 50; [2] Ralston; Powell, 525; Garland, 50; [1] Mantua; and [1] Frannie, Wyo.

WATER SUPPLY.

Source of water supply: Shoshone River.

Area of drainage basin: 1,380 square miles.

Annual run-off in acre-feet: Shoshone River near Cody (1,380 square miles), 1903 to 1915—maximum, 1,420,000; minimum, 846,372; mean, 1,127,837.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which service is prepared to supply water, season of 1916: 42,665 acres.

Works constructed for fifth unit, but not open to entry: 3,562 acres.

Area under water-right applications, season of 1916: 37,570 acres.

Area under rental contracts, season of 1916: 150 acres.

Length of irrigating season: From April 10 to November 10.

Average elevation of irrigable area: 4,500 feet above sea level.

Rainfall on irrigable area: 1907–1915, average, 5.92 inches; 1915, 9.19 inches.

Range of temperature on irrigable area: —31° to 101° F.

Character of soil of irrigable area: Light sandy and clay loams.

Principal products: Alfalfa, grain, sugar beets, vegetables, cattle, hogs, and dairy products.

Principal markets: Omaha, Nebr.; Kansas City, Mo.; Chicago, Ill.; Denver, Colo.; Billings, Mont.; and local.

LANDS OPENED FOR IRRIGATION.

Dates of public notices and orders relating thereto: November 25, 1907; April 3, 1908; May 8, 1909; February 6, March 25, May 20, November 8, 1911; February 9, March 23, July 17, 1912; January 17, February 26, June 23, July 15, July 21, 1913; January 19, May 29 (memorandum), September 24, 1914; March 1, March 20, September 25, October 9, 1915; March 16, June 3, 1916.

Location of lands opened: Tps. 54 to 56 N., Rs. 98 to 100 W., sixth principal meridian.

Present status of irrigable lands opened: 36,745 acres of public and 825 acres of private lands under water-right application, 3,847 acres of unentered public land, and 1,245 acres of private and State land open to entry for which water is available, but for which no water-right application has been made; 3.54 acres of land included in United States reserves.

Limit of area of farm units: Public, 80 acres; private, 160.

Duty of water: 2 acre-feet per acre per annum at the farm.

Building charge per acre of irrigable land: $57 on first unit, $58 on second unit; $59 on third and fourth units; charge for fifth unit not yet announced.

Annual operation and maintenance charge: 70 cents per acre of irrigable land whether water is used or not, for which 2 acre-feet of water may be delivered; 15 cents for the third acre-foot; and 25 cents per acre-foot for all additional water.

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[1] Railroad siding only.

[2] Population less than 25.

CHRONOLOGICAL SUMMARY.

Reconnoissance made and preliminary surveys begun in 1903.
Construction recommended by board of engineers, February 1, 1904.
Construction authorized by Secretary February 10, 1904.
Corbett diversion dam completed June, 1907.
Corbett Tunnel completed November, 1907.
First irrigation by Reclamation Service, season of 1908.
Shoshone Dam completed January, 1910.
Entire project 50 per cent completed June 30, 1916; first, second, third, fourth, and fifth units completed.

IRRIGATION PLAN.

The irrigation plan of the Shoshone project provides for the storage of flood waters of Shoshone River in a reservoir controlled by Shoshone Dam, about 8 miles above Cody, Wyo.; the diversion of water from Shoshone River by a dam at Corbett, about 16 miles below the reservoir, and through the Corbett Tunnel into a canal system supplying water to lands on the north side of the river in the vicinity of Ralston, Powell, Garland, Mantua, Frannie, and Deaver; the diversion into the Willwood Canal for the irrigation of lands on the south side of the Shoshone River; and the diversion into the north side High Line from the Shoshone Dam for the irrigation of lands lying on the north side of the Shoshone River above the Garland Canal system and extending from the lower end of the Shoshone Canyon near Cody to the divide between the Shoshone River and Clarks Fork drainage.

The United States claims all waste, seepage, spring, and percolating water arising within the project and proposes to use such water in connection therewith.

The Shoshone Dam, Corbett Dam, Corbett Tunnel, Garland Canal, about 13 miles of the Frannie Canal, the lateral and distributary system for approximately 43,000 acres in the vicinity of Ralston, Powell, and Garland, Wyo., and the major portion of the canal system for the irrigation of the first unit of about 11,800 acres on the Frannie division have been completed.

Future operations include the construction of the Willwood and High Line Canals and the completion of additional units on the Frannie division.

SUMMARY OF GENERAL DATA FOR SHOSHONE PROJECT TO JUNE 30, 1916.

Areas:		
Irrigable acreage when project is complete		147, 365
Public land entered, June 30, 1916	36, 745	
Public land open to entry, June 30, 1916	3, 847	
Public land withdrawn, June 30, 1916	98, 210	
State land, June 30, 1916	6, 326	
Private land, June 30, 1916	2, 237	
Acreage service could have supplied season of 1915		42, 816
Estimated addition in fiscal year 1917		11, 876
Estimated acreage service can supply July 1, 1917		54, 712
Acreage actually irrigated, season of 1915		25, 753
Acreage cropped under irrigation, season of 1915		24, 833
Crops:		
Value of irrigated crops, season of 1915		$410, 031. 00
Value of irrigated crops, per acre cropped		16. 51
Finances:		
Estimated cost of completed project		$9, 936, 000. 00
Total construction cost to June 30, 1916		$4, 542, 980. 13
Per cent complete, June 30, 1916		50
Appropriation for fiscal year 1917, total		$762, 000. 00
Allotment for construction, fiscal year 1917		$595, 700. 00
Estimated per cent complete, June 30, 1917		53
Announced construction charges per acre		$57, $58, $59

Finances—Continued.			
Appropriation, fiscal year 1916		$478,000.00	
Decrease under 10 per cent provision of act		43,300.00	
Total appropriation			$434,700.00
Expenditures during fiscal year chargeable to 1916 appropriation—			
Disbursements	$221,067.72		
Transfers	19,832.19		
		$240,899.91	
Registered liabilities chargeable to 1916 appropriation		53,186.22	
			294,086.13
Unencumbered balance July 1, 1916			140,613.87
Repayments:			
Construction charges—			
Accrued to June 30, 1916			266,132.70
Collected to June 30, 1916			260,423.45
Uncollected, June 30, 1916			5,709.25
Operation and maintenance charges (public notice)—			
Accrued to June 30, 1916			133,113.54
Collected to June 30, 1916			123,554.03
Uncollected, June 30, 1916			9,559.51
Drainage:			
Estimated acreage damaged by seepage June 30, 1916			1,000
Miles of drains built to June 30, 1916—			
Open		10.32	
Closed		55.05	
			65.37
Estimated acreage protected by drains built to June 30, 1916			15,500
Estimated acreage to be protected by authorized system			20,500
Expended to June 30, 1916, on drainage works, completed and uncompleted			$468,477.16

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

ROADS.

In order to prepare for the construction of Shoshone Dam it was found desirable to have a road through the canyon by which to gain easy access to the cliffs above the elevation of the top of the dam.

The construction of such a road on the north side of the canyon was begun by Government forces in 1904, and early in 1905 the road was completed for a distance of 4 miles from the mouth of the canyon to the site of the dam. For the greater part of this distance the road was cut into the solid rock of the walls of the canyon.

On account of the fact that a road formerly used in entering Yellowstone Park passed through the site of the reservoir, the canyon road has been extended for a distance of 14 miles from the site of the dam around the flow line of the reservoir until it joins a newly constructed county road that connects with other roads entering the park. Surveys for this extension, known as the Shoshone Reservoir highway, were made in 1908, and its construction was begun in 1908 and completed in 1910.

The old trail from Cody to Yellowstone Park was located on the south side of Cedar Mountain, crossing the South Fork of the Shoshone River near Marquette and continuing thence along the south side of the North Fork. The construction of Shoshone Reservoir submerged several miles of this road and left no outlet for the ranchers living between the two forks of the river. The Reclamation Service prepared plans for the construction of 11 miles of Between Forks Highway. One-half of the work was completed in the fall of 1911 and a steel bridge erected across the South Fork of Shoshone River. The county officials agreed to cooperate with the Reclamation Service in the construction of this road to the extent of securing all necessary rights of way. Because of some difficulties arising in securing such rights of way construction work was suspended and not resumed until April, 1914, when a short reach was completed at the crossing of the Cody Canal. The balance of the road, which runs along the south side of the north arm of the reservoir, was completed in the spring of 1915.

SHOSHONE DAM.

The Shoshone Dam is located on Shoshone River a short distance below the confluence of its north and south forks and near the upper end of Shoshone Canyon. The dam is a monolithic rubble concrete structure of the arch type, the radius of the center line of the top of the dam being 150 feet. The maximum height from the rock foundation to the top of the parapet is 328 feet.

The main outlet of the reservoir formed by the dam is a concrete-lined tunnel 498 feet in length, having a section 10 feet wide by 10 feet high at the sides with an arched roof of 16-inch rise. The tunnel was driven through the granite cliff on the south side of the canyon. The elevation of the floor of the tunnel at its upper end is 5,140, and at its lower end 5,137.

A second outlet tunnel, also on the south side of the canyon, has its inlet floor at elevation 5,250. It is 10 feet square in section, has a length of 300 feet, and is unlined.

On the north side of the reservoir, several hundred feet upstream from the dam, there is a concrete spillway weir 300 feet long, discharging at elevation 5,360 into an open channel and thence into an unlined tunnel excavated to a section 20 feet wide and 20 feet high at the sides with a roof arch having a rise of 2 feet 8 inches. The spillway tunnel is 405 feet in length, has a slope of 10 feet in 100, and discharges through an open channel into the river about 300 feet below the dam.

In connection with the construction of the dam, spillway, and main outlet tunnel, there was also required on the north side of the canyon an unlined road tunnel 166 feet in length with a cross section 9 feet wide by 12 feet high.

Plans for the construction of Shoshone Dam, spillway, and outlet, spillway and road tunnels, were prepared in 1905 and considered in June of that year by a board of engineers consisting of Messrs. A. P. Davis, G. Y. Wisner, A. J. Wiley, J. H. Quinton, D. C. Henny, and H. N. Savage. Proposals were opened September 5, 1905, and contract was executed September 23, 1905. Work on the outlet tunnel was begun November 21, and the construction of temporary diverting works was begun December 12, 1905. In May, 1906, work on the outlet tunnel was discontinued on account of high water in the river, and in June of that year the temporary dam was partly destroyed.

In August, 1906, it became necessary to suspend the contract on account of the failure of the contractor to prosecute the work satisfactorily. On September 10 a new contract was executed by the bondsmen of the first contractor and reconstruction of the temporary dam we begun in November of that year.

In April, 1907, the excavation of the outlet tunnel was resumed and it was completed May 10.

The temporary works required for diverting the flow of the river during the construction of Shoshone Dam consisted of a rock-filled crib dam, 300 feet long and 18 feet high; a timber flume 1,340 feet long, 13 feet wide, and 8 feet high, discharging into the outlet tunnel, and another flume 400 feet long, 10 feet wide, and 8 feet high, heading at the lower end of the outlet tunnel. The portions of the temporary dam and flume destroyed by flood in June, 1906, were reconstructed in November of that year. The dam was repaired again in April, 1907, and the upper flume connected with the outlet tunnel, the flume being finally completed on May 18, 1907. The lower flume was constructed in the fall of 1907.

Excavation for the foundation of the Shoshone Dam was begun December 2, 1907, and completed April 1, 1908.

The placing of concrete in the dam was begun March 30, 1908, and completed January 16, 1910.

The excavation of the road tunnel was begun May 12, 1906, and completed January 17, 1907.

The open-cut excavation for the spillway was begun in April, 1906, and completed in April, 1909; and the driving of the spillway tunnel was begun September 3, 1908, and completed in April, 1909.

Construction of the upper outlet tunnel for the reservoir was begun December 20, 1909, by Government forces. At the end of May, 1910, the driving of the tunnel had been completed except for the excavation of a part of the bench in the lower end.

High-pressure gates.—In the gate chamber near the discharge end of the outlet tunnel of the Shoshone Reservoir are installed three cast-iron gates each 7½ feet high by 4½ feet wide and controlling a waterway 7 feet high by 3 feet 8 inches wide. Proposals for supplying and installing the gates and operating mechanism were opened on December 20, 1906, and a contract was executed February 14, 1907. The contractor was required to erect the gate frames and install the gates and operating mechanism, but the excavating required and the placing of the necessary concrete were done by the United States. The manufacture of the gates was begun by the contractor soon after the execution of the contract, and the delivery at the project of the gates, gate frames, and operating mechanism was made in May and June, 1908, and the installation was completed in August, 1908.

Upon completion of the dam work for the next few years was confined to some minor improvements in the road in the immediate vicinity of the dam so as to make it safe for public travel. A wooden stairway was erected down the north canyon wall to the balcony across the downstream face of the dam and the steel ladder which gives access to the operating chamber, where is located the machinery for operating the high-pressure gates. Some additional survey work was required to complete the necessary drawings covering the flowage lands within the limits of the reservoir.

During the fiscal year 1911 work was limited to necessary operation and maintenance work in controlling the reservoir. A portion of the reservoir site was fenced. In the spring of 1912 it was decided to raise the water surface in the reservoir by closing the 42-inch pipes through the base of the dam by means of stop planks placed at the upper end and after accomplishing this to plug the upper outlet tunnel, if found necessary, with a large mass of concrete. Some difficulty was experienced in lowering the water to an elevation where the stop planks could be placed over the 42-inch pipes, and this plan was abandoned and steps taken to place the concrete plug in the upper outlet tunnel. While this work was in progress the sliding gates in the lower outlet tunnel were left wide open. Upon completion of the concrete plug some difficulty was experienced in closing the high-pressure gates, but this was finally accomplished although the water stood at a depth of 127 feet above the valve seat.

Installation of valves on 42-inch outlet pipes.—In January, 1913, work was started on the installation of twin 30-inch valves at the lower end of the 42-inch pipes through the base of the dam. These pipes had heretofore been discharging free. The low flow of the river was handled through the high-pressure sliding gates. The work involved the excavation of about 100 yards of loose rock so as to lower the water below the elevation of the pipes, the placing of four gates, each weighing 5,700 pounds with necessary reducers, and the placing of 32 yards of concrete in the gatehouse around the twin valves. The lowering of the reservoir in the fall of 1912 left a large area of land where the vegetation had been destroyed. This area became very dry, and the heavy winds coming down through the mountain passes picked up the fine sand which drifted to the farms immediately adjoining the reservoir and filled the air with a great cloud of dust which was noticeable at distances of many miles. The damage caused to farms in the vicinity of the reservoir by this drifting sand made it necessary to purchase the fee title of three of the farms and the payment of $14,760.97 damage claims in eight additional cases. The total expenditure amounted to $38,654.97. In addition to this trouble, there was also some damage in the vicinity of Kane, Wyo., which is located at the confluence of the Shoshone River with the Big Horn. At the time that surplus water in the reservoir was being drawn off severe cold weather prevailed, causing a considerable quantity of ice to form and block the channel so that water and ice overflowed the adjacent farms. In many instances the landowners were obliged to vacate their houses because of the flooded condition of the farm. An adjustment of the claims resulting from this overflow covered a total of 26 cases and a payment of $8,452.95.

Upon completion of the installation of the 30-inch valves they were left open so as to pass a sufficient quantity of water for the irrigable lands under the Shoshone project, as well as private rights below, until the flood waters began to discharge over the spillway of the reservoir. As soon as water began to overflow the spillway an attempt was made to close the twin valves on the 42-inch pipes, which was successfully accomplished with the right pair, but with the left pair the valves were not entirely closed and the vibration resulting from the water discharging through a small opening under a head of 220 feet eventually brought about the failure of the connecting bolts, and the lower valve on the left pipe was torn loose sometime in the spring of 1914. A few months later the second valve on this same pipe was also torn from its fastening. No attempt has been made to close this pipe, as it is necessary throughout the entire year to discharge some water from the reservoir and this one pipe satisfactorily meets all requirements, except during the height of the irrigation season.

Installation of balanced valves.—During 1913 and 1914 the principal control of the stored waters in Shoshone Reservoir was limited to the water held above the elevation of the spillway by means of temporary wooden frames and stop planks. Consideration was given to the installation of the additional controlling works which it was not considered advisable to install during the construction of the dam. A report was submitted under date of April 26, 1914, by a board of engineers consisting of Messrs. O. H. Ensign, D. C. Henny, A. J. Wiley, and H. N. Savage, fully discussing the controlling conditions and recommending the installation of two positive-control Ensign balanced valves in the lower outlet tunnel, with a removable steel bulkhead closing the lower end of this tunnel and provision made for the water to discharge through short openings through the side of the canyon wall. The plans were approved and preliminary work started the following August. The first work consisted in enlarging the river channel on the lower side of the dam so as to lower the water in the lower outlet tunnel, which at the beginning of the work was 5½ feet deep. The operating chamber, which gave access to the controlling works for the high-pressure sliding gates, was enlarged so as to permit the installation of the controlling works for the balanced valve. In the lower outlet tunnel a considerable quantity of rock was excavated to permit the installation of the valves and some very careful work was performed in replacing the concrete lining so as to successfully eliminate the possibility of excessive hydrostatic pressure against the back of the concrete lining, which might possibly result in its destruction. This was accomplished by placing two separate linings, the first of which was somewhat porous in character connecting with tile drains through which water could be discharged into the tunnel below the bulkhead. Before placing the second lining the first concrete was coated with a layer of concrete mortar applied with a cement gun and followed with a waterproof material applied at a temperature of 300° F. The second 9-inch layer was then placed, this being a rich mixture, carefully tied to the first lining by means of reinforcing steel. This work was carried on throughout the winter months of 1914 and 1915, and was completed in May of the latter year. A preliminary test of the new controlling works developed a weakness in the removable steel bulkhead which was repaired in August and the controlling works successfully tested in November, 1915. Further tests were carried on in the spring of 1916, which successfully showed that the stored waters of Shoshone Reservoir are now under complete and full control, and a sufficient quantity of water can at all times be discharged from the reservoir to supply all of the lands which are irrigable under the Corbett division and also the lands which will be irrigated from the Willwood division, as well as prior rights which are located below the Shoshone project.

CORBETT TUNNEL.

In the plans for diverting water from Shoshone River for irrigation of lands on the north side, an important feature is the Corbett Tunnel, heading at the Corbett Diversion Dam, about 16 miles below the Shoshone Dam and 8 miles from Cody, Wyo. The controlling gates at the head of the tunnel were installed in connection with the Corbett Dam, but at the outlet of the tunnel there was constructed in connection with it a settling basin, from which the main canal receives its water supply. A spillway for the settling basin, with crest at elevation 4,598, was excavated in rock near the east end of the dam and a sluicing tunnel was built from the settling basin to the river.

Specifications for the construction of the Corbett Tunnel and settling basin were prepared in 1905, and reviewed and recommended by a board of engineers consisting of Messrs. A. P. Davis, A. J. Wiley, and H. N. Savage. Proposals for the work were opened September 6, 1905, a contract was executed September 27, and work was begun November 3, 1905. On August 4, 1906, it became necessary to suspend the operation of the contract on account of the failure of the contractor to prosecute the work satisfactorily. On August 17, 1906, the work of construction was taken up by the Reclamation Service. The driving of the tunnel was completed August 2, 1907, and the whole work of the contract was finished November 20, 1907.

The excavation for the tunnel was carried forward from both portals; from three adits, located, respectively, at stations 33 + 57.2, 91 + 8.4, and 121 + 52.6; and from a shaft at station 155 + 0.

Adit No. 1 was completed January 14, 1906, and the excavation of the tunnel proper was then begun. Adits Nos. 2 and 3 were completed March 10, 1906. Excavation at the intake was begun in May and at the outlet portal December 8, 1906. Excavation at the shaft was begun June 9 and reached the tunnel section in September, 1906.

In March, 1906, the contractor began excavating for the puddled trench of the earth dam for the settling basin. After excavating the trench to a depth of 4 feet, the work was suspended until August 1, when it was resumed by a subcontractor. When the main contract was suspended, the subcontractor continued work on the dam for the settling basin, and the Reclamation Service later made a contract with him for the completion of the work.

The excavation of the sluicing tunnel for the settling basin was begun January 10, 1906, and completed May 1. The lining of the tunnel with concrete and the construction of the gate house, gate-house shaft, and intake and outlet portals were completed, and the gate was installed in March, 1907.

CORBETT DAM.

For the purpose of diverting water from Shoshone River into the Corbett Tunnel the Corbett Dam, located about 8 miles from Cody, Wyo., was constructed. This dam is a reenforced concrete weir.

Plans for the dam were reviewed in May, 1906, by a board of engineers consisting of Messrs. A. J. Wiley, H. N. Savage, Jeremiah Ahern, and C. P. Williams, and specifications recommended by the board were approved by the department. Proposals under these specifications were opened July 10, 1906, and a contract for the work was executed August 6, 1906. The work of construction was begun in the fall of that year and completed in June, 1907.

CANAL AND DISTRIBUTION SYSTEM.

Garland Canal.—The main part of the water required for irrigating the lands on the north side of the Shoshone River is supplied through the Garland Canal, heading at the settling basin at the mouth of the Corbett Tunnel. The canal extends in a northeasterly direction a distance of about 8 miles, discharging into Ralston Reservoir, from which the canal is extended a farther distance of about 10 miles to supply various laterals for conveying the water to the lands to be irrigated.

Ralston Reservoir, located at the end of division 1 of the Garland Canal, is a small reservoir, having an area of about 200 acres, formed in a natural depression by the construction of an earth dam 2,200 feet in length with a maximum height of 40 feet and an average height of about 10 feet.

Designs for the construction of division 1 of the Garland Canal were reviewed in March, 1906, by a board consisting of Messrs. A. P. Davis, A. J. Wiley, and H. N. Savage. Specifications for the excavation of this division and for the erection of a part of the structures thereon, recommended by the board, were approved by the department and advertisement was issued inviting proposals to be opened May 24, 1906. Only one proposal was received, and that was rejected as unsatisfactory, and the work readvertised with a change in the date for required completion. The proposals received under this readvertisement were opened July 11, 1906; a contract for the work was executed November 2, 1906; and the work was completed August 10, 1908. Specifications for the erection of other structures on division 1 of the Garland Canal, reviewed and recommended by the same board, were approved by the department July 3, 1906, and advertisement was issued inviting proposals to be opened August 23, 1906. No proposals were, however, received. On March 18, 1907, an informal proposal, modified as to dates and requirements, was received, a contract was executed April 9, 1907, and the work was completed in February, 1908.

Plans for the construction of divisions 2, 3, and 4 of Garland Canal and of lateral systems diverting water therefrom for the irrigation of about 40,000 acres of land were reviewed in January, 1907, by a board of engineers consisting of Messrs. A. J. Wiley, H. N. Savage, and R. S. Stockton. Specifications for the excavation of these canals, recommended by the board, were approved by the department on January 8, 1907. Proposals were opened March 12, 1907, and four contracts for different parts of the work were awarded. The contracts were executed on April 8, April 12, April 13, and April 27, respectively, and the larger part of the work under all of the contracts was completed by March, 1908, and all of it by November, 1908. On divisions 5, 6, 7, and 9 of the laterals, comprising what is known as the Frannie Canal, all bids were rejected and the work of constructing the major part of these laterals postponed, although a small amount of work was done by Government forces in excavating to part section the first 2 or 3 miles of the Frannie Canal and in completing the laterals served by this part of the canal.

Frannie Canal was constructed from its head gates for a distance of about 12 miles under contracts which were completed in May, 1911. This canal has an initial capacity of 550 second-feet and carries water for the irrigation of about 8,500 acres in the Garland division, and will eventually be extended to irrigate about 40,000 acres of land in the Frannie division. The distributing ditches under lateral "A" and the Frannie Canal were also constructed under contract. The concrete structures were constructed by Government forces, and this work was completed in July, 1912. The first portion of lateral "A" and the Frannie Canal furnished water to the fourth unit on the Garland division, which was opened to entry by public notice of March 23, 1912.

The temporary wooden flume which was constructed in 1908 for the purpose of carrying the Garland (main) Canal across the valley of Alkali Creek had deteriorated to such an extent that it was not considered safe to operate it longer at its full capacity, and this structure was replaced by a concrete-lined canal 2,035 feet long and a metal flume supported on a wooden trestle for a distance of 293 feet. The canal at this point has a capacity of 850 second-feet and the water drops a vertical distance of 52.2 feet. Work was started in the latter part of March, 1914, and with the exception of the upper end was completed in the latter part of June. A temporary wooden connection was made with the main canal so that the new structure could be operated during the last half of the irrigation season of 1914. The work was finally completed in November of that year.

Plans for structures on canals the excavation of which was provided for by specifications No. 128 were reviewed in February, 1907, by a board of engineers consisting of Messrs. A. J. Wiley, H. N. Savage, and Jeremiah Ahern, and specifications for the erection thereof, recommended by the board, were approved by the department on February 20, 1907, and advertisement was issued inviting proposals to be opened April 17, 1907. No proposals were received, and the building of these structures by Government forces was authorized on May 1, 1907. The work was begun promptly and carried on systematically. In June, 1908, the structures for a first unit of about 15,000 acres of irrigable land had been completed, and in May, 1910, the structures for a second unit of about 16,000 acres were completed.

In the fall of 1909 the excavation on the Ralston unit of laterals and waste-water ditches diverting water from the first division and the upper part of the second division of the Garland Canal was undertaken by contract and completed in June, 1910.

Proposals for supplying the metal work for two steel-truss 60-foot span highway bridges were opened May 15, 1907, and a contract was executed July 22, 1907. The delivery of this material was completed in October, 1907, and the bridges were erected by Government forces, the erection being completed in February, 1908.

Lateral "A" extension.—On October 22, 1914, proposals were opened for the construction of about 8 miles of lateral "A" extension with the necessary distributary canals for delivering water to about 3,500 acres of land located in the northerly portion of the Garland division. Contract for the earthwork was awarded to R. M. Lynn, of Lovell, Wyo., and the structural work was awarded to Threet Bros. & Jolley, of Lovell, Wyo. The contractors promptly started on this work and weather conditions were such that it was possible to move dirt throughout the entire winter. Concrete work was completed May 31, 1915, and the canals primed in June. This canal delivers water to the fifth unit which was opened to entry by order of October 9, 1915.

Relocation lateral "T."—A petition was received from a number of unit holders on the Garland division requesting the relocation of the lower portion of lateral "T." The petition was referred to the water users' association September 17, 1914, and the following December the board of directors recommended that the change be made. This work was included in the program of supplemental construction which was favorably acted upon by the water users in a general ballot, in connection with the increased charge of $7 per acre for carrying on drainage and miscellaneous supplemental construction. Advertisements for the work were issued and proposals received May 17, 1915. The work was awarded to Threet Bros. & Jolley, of Lovell, Wyo., who completed the work the following year.

DRAINAGE.

Water was first delivered to the irrigable lands on the Garland division in 1908. Prior to this time it was the general belief that there would be very little trouble from seepage, as the area south of Bitter Creek is underlain with gravel and the irrigable land is from 100 to 150 feet above the bed of Shoshone River, with a general slope toward the northeast of about 25 feet per mile, which seemed to furnish ample opportunity for the subsurface waters to gain access to the river through natural underground channels. Later developments showed that portions of this gravel were sufficiently impervious to hold back the water, forming what might be called underground lakes which kept rising until the surface soil became saturated with water. Observations of the wells within the area irrigated showed a rapid rise of the underground water, and by 1910 seeped lands had developed. There was a very high water plane on an area of 8,000 to 10,000 acres in the vicinity of Powell and Garland. Investigations were continued throughout 1911 and plans approved for the relief of the water-logged lands. Proposals were secured for the construction of about 12 miles of open subsurface drains and contract was awarded to Lynn & Arnoldus, October 30, 1911. Work was started November 7, but unusually severe winter weather resulted in slow progress being made and at a considerable loss to the contractor. The contract was suspended April 18, 1912, with the work 18 per cent completed, and was immediately carried on by Government forces, who finished 65 per cent of the 12 miles of drains on November 8, 1912. It was fully realized that the rapid spread of seepage required very energetic action in order to relieve and protect the lands lying south of Bitter Creek, and authority was granted in 1912 for the construction of about 27 miles of tile drains. Work was started August 7, 1912, with a drag-line excavator, and on October 4 an Austin trench excavator was put in operation. A second drag line was purchased and placed in commission June 23, 1913. These machines were kept in operation throughout the working season of 1913, and since the spring of 1914 drainage work has been continued with one drag-line excavator and the Austin trencher.

CONSTRUCTION DURING FISCAL YEAR.

Canal system, Frannie division.—Proposals for the construction of earthwork and structures, first unit Frannie division, were received at the project office until October 20, 1915. Satisfactory prices were received for schedules 1, 2, and 3, which comprised the earthwork. Contract No. 665, dated November 17, 1915, was entered into with Threet Bros. & Jolley, of Lovell, Wyo., for schedules 1 and 3 of specifications 317, and contract No. 674, dated November 29, 1915, was entered into with R. M. Lynn, of Lovell, Wyo., for schedule 2, specifications 317. The proposals received for schedules 4 and 5, which comprised the structural work, were considered excessive and were rejected. Good progress has been made throughout the fiscal year. Schedule 1 was completed June 9. The contracts covering schedules 2 and 3 require the completion of this work on or before September 30, 1916. On June 30, 1916, the earthwork was about 56 per cent complete.

The structural work was readvertised and proposals opened at the project office May 3, 1916. The prices received for the construction of schedule 1 of specifications 331 were considered fair, and contract No. 698, dated June 9, 1916, was entered into with the Security Bridge Co., of Minneapolis, Minn. The date of completion of the work covered by schedule 1 is November 30, 1916. No actual construction work had been completed at the end of the fiscal year.

The proposals submitted for the construction of schedule 2 were considered excessive and were rejected. On May 23, 1916, authority was given to complete this portion of the work with Government forces, and steps were taken immediately to assemble an organization. Up to the end of the fiscal year work had been confined to erecting construction camps and general miscellaneous work preliminary to starting on the erection of structures.

Shoshone Dam controlling works.—The preliminary tests of the 58-inch balanced valves at Shoshone Dam developed a weakness in the removable steel bulkhead, which is located 90 feet below the high-pressure sliding gates. Necessary repairs were completed in August and September, and the gates partially tested in November. Further tests were carried on in the spring of 1916, and the valves were found to work in a very satisfactory manner. The completion of this work now gives control of Shoshone Reservoir under all conditions, and it will be possible to release about 2,000 cubic feet of water per second for the irrigation of lands within the limits of the Shoshone project, as well as prior rights on the Shoshone River, which are located in the vicinity of Byron, Cowley, and Lovell, Wyo.

SEEPAGE AND DRAINAGE.

During the season of 1915 there were 1,157 acres of water-logged land on the Garland division, and 1,039 acres which had been relieved by constructed drains but which had not been reclaimed so as to produce profitable crops. In May, 1915, the water users voted favorably for an increase of $7 per acre in the construction charges, to be used in extending the drainage system for the relief of lands which were water-logged and the protection of other lands which were threatened with seepage. This work had been carried on actively throughout the fiscal year with one Lidgerwood drag-line excavator and one Austin trench excavator, both machines being employed two shifts throughout the entire working season. Excellent progress has been made, and 16.2 miles of closed tile drains have been constructed. The drag-line excavator has been engaged for four months in deepening Bitter Creek for a distance of 1.7 miles. At the close of the fiscal year drains have been constructed for the relief and protection of all but five or six areas of water-logged lands, and with the progress that has been made it is believed that by the close of the working season of 1916 all of the principal seeped areas will have been relieved. It is quite probable, however, that new areas will be affected by seepage.

One of the surprising things about the drainage system on the Shoshone project is the large quantity of water removed by the subsurface drains. Practically all of the land affected by seepage has a gravelly subsoil, and in most locations there is a rather free movement of the underground water, but streaks of hardpan and impervious material obstruct the underground flow which fills the subsoil and water begins to show upon the surface of the ground. The drains tap and remove this underground water. The discharge varies directly with the quantity applied to the irrigable lands, and the records show that with large increases in the quantity of water applied to the irrigable lands the drainage system begins to show an increased discharge from three to four days thereafter. The maximum discharge from 60 miles of subsurface drains was 61 cubic feet per second. This occurred on June 30, 1916.

It is not possible to state with any definiteness what further extensions will be required in the drainage system. There will be several areas that can not be relieved until during the working season of 1917, and by that time there is reason to believe that the end will be in sight, unless some unforeseen condition arises requiring the construction of drainage works in portions of the project which have not thus far shown signs of becoming water-logged.

The following statement shows the extent of the area affected by seepage from 1911 to 1916, inclusive:

Item.	1911	1912	1913	1914	1915	[1] 1916
Acreage too wet to cultivate	874	2,014	1,973	1,439	1,357	900
Acreage so affected as to materially reduce crop yields	655	1,316	878	878	1,039	960
Number of farm units affected	111	180	174	176	180	170

[1] To June 30, 1916.

ECONOMIES OF GOVERNMENT WORK.

With the exception of a few miles of open drains, all drainage work has been constructed by Government forces. At the close of the calendar year 1914 the average cost per linear foot for 38.55 miles of closed tile drain was $1.39. In 1915, 9.15 miles of closed tile drains were constructed, at an average cost of $1.06 per linear foot.

OPERATION AND MAINTENANCE.

On the Garland division there are 37,570 acres covered by water-right applications, which comprise 88 per cent of the irrigable area. It is estimated that about 32,000 acres of land will be cultivated and cropped during the season of 1916. The delivery of water to these lands requires the operation of Shoshone Dam, Corbett Dam and Tunnel, and about 10 miles of the main supply (Garland) canal, with its 10 main laterals and 93 sublaterals, aggregating 267 miles in length. Satisfactory service is given in practically every instance. There are times, especially after the cutting of the first crop of alfalfa, when it is not possible to supply all of the water demanded by the water users. This is not the fault of the canal system, as in all instances it is possible to supply water in excess of the legal requirements. On some of the sublaterals water is delivered by rotation, and in such cases it is possible to deliver satisfactory irrigating heads. In other instances the best service possible is given to the water users, but no rigid system of rotation has been put into practice. There is still too much water being wasted, and the quantity during 1916 is in excess of the amount wasted in 1915. This increase is due largely to the 42 new farms under lateral "A" extension, which are being irrigated for the first time in 1916. In most instances the entrymen are inexperienced irrigators, and the land is somewhat steeper than most of the farms on the Garland division, resulting in considerable quantities of surface waste.

The average annual rainfall on the Shoshone project is less than 6 inches, and it is necessary to supply water early in the season for the germination of crops. Water is usually turned into the canal system about the middle of April and deliveries continued until the latter part of October. This leaves very little time to carry on necessary maintenance work, and to overcome this difficulty arrangements were made in the fall of 1915 for discontinuing the delivery of water from the 25th of September to the 25th of October, and then resuming operations for a period of about two weeks in order to supply water to such lands as required late irrigation. During the intervening period the necessary maintenance work was carried on by the employees of the operation and maintenance department. This arrangement proved very satisfactory and will probably be continued another year.

Historical review, Shoshone project.

Item.	1912	1913	1914	1915	1916 [1]
Acreage for which service is prepared to supply water	41,332	41,309	41,168	42,816	42,665
Acreage irrigated	16,524	19,423	22,226	25,753	31,000
Number of farms irrigated	346	396	420	498	577
Miles of canal operated	242	242	245	247	267
Water diverted (acre-feet)	50,100	69,767	92,340	96,217	45,280
Water delivered to land (acre-feet)	27,370	40,436	52,789	54,668	25,400
Per acre of land irrigated (acre-feet)	1.66	2.08	2.38	2.12	0.82

[1] To June 30, 1916.

SETTLEMENT.

During the fiscal year 1916 a total of 71 lots were sold in Powell town site at an appraised value of $10,338. The total return to the reclamation fund from the sale of town lots to June 30, 1916, amounts to $70,465.50. Considerable building activity is under way, and residences and business houses of a substantial character are being erected. A waterworks system costing approximately $65,000 was installed during the year, and several hundred feet of concrete sidewalks were constructed.

Ninety-two original homestead entries, aggregating a total of 6,735.66 acres of irrigable land, were made during the year. Of this number, 42 farms, totaling 3,230.51 acres, were under the fifth unit, known as lateral "A" extension, which was opened to entry October 20 to 25. In cases where more than one application was made for a farm unit, a drawing was necessary to determine the successful applicant. By October 23, 1915, there had been received 133 applications for 35 farm units, and by the end of October the remaining 7 units were disposed of.

Fifteen farm units, aggregrating 753.07 acres, were purchased by assignment. On these farms the purchaser assumes the unpaid water-right charges still owing the Government. Twenty-two farm units, 1,270.13 acres of irrigable land, were relinquished to the United States and immediately filed on by friends or relatives of present entrymen. No farm units were canceled for the nonpayment of charges.

At present there are about 50 farm units open to entry. Some of these units are rough in character and are not very attractive to prospective settlers, and for this reason the rate of settlement has been rather slow.

Good progress is being maintained on the construction of the first unit of the Frannie division of about 11,800 acres, and it is intended that these lands shall be opened to settlement some time during the fall of 1916. Considerable interest is being manifested in this division of the project and indications point to a large number of applicants for the farms under the first unit.

Settlement data, Shoshone project.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	612	615	616	609	650
Population	[1] 1,700	[1] 1,279	[1] 1,400	[1] 1,500	[1] 1,800
Number of irrigated farms	360	396	424	460	577
Operated by owners or managers	....	349	359	363	458
Operated by tenants	....	47	65	97	119
Population	[1] 1,700	[1] 1,279	[1] 1,400	[1] 1,500	[1] 1,800
Number of towns	3	3	3	3	4
Population	[1] 500	[1] 515	[1] 525	[1] 515	[1] 650
Total population in towns and on farms	[1] 2,200	[1] 1,794	[1] 1,925	[1] 2,015	[1] 2,450
Number of public schools	6	6	6	6	6
Number of churches	6	6	6	7	7
Number of banks	3	3	3	3	3
Total capital stock	$60,000	$60,000	$60,000	$60,000	$60,000
Total amount of deposits	$125,000	$146,000	$156,664	$177,228	$252,746
Total number of depositors	800	850	1,037	1,290	1,500
Number of relinquishments	34	16	14	13	22

[1] Estimated.

PRINCIPAL CROPS.

During the season of 1915, 25,753 acres were irrigated, of which 24,833 acres were cropped. The gross returns amounted to $410,031, or an average of $16.51 per acre, which was an increase of $1.50 per acre over 1914. Alfalfa, with 12,185 acres, continues to be the principal crop, with an average yield of 2.19 tons per acre. Oats, wheat, and barley run next with a total of 9,024.75 acres. The acreage in sugar beets was somewhat less than the preceding year. Three sugar-beet dumps are now erected on the project and two alfalfa mills are in operation, one at Powell and the other at Garland. The Powell Cooperative Creamery continued operations throughout the year, and the demand for the product is in excess of the supply.

Crop report, Shoshone project, Wyoming, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	12,185	Tons	26,641	2.19	$7.00	$186,487	$15.30
Alfalfa seed	291	Bushels	479	1.64	9.00	4,311	14.79
Apples	1.25	Pounds	306	244.80	.04	12	9.79
Barley	883	Bushels	16,696	18.91	.75	12,522	14.18
Beans	11.75	...do	59.5	5.06	2.40	143	12.15
Beets, sugar	1,115	Tons	8,141	7.30	6.00	48,846	43.81
Clover hay	21.5	...do	22	1.02	7.00	154	7.16
Clover seed	197	Bushels	442	2.25	9.00	3,978	20.24
Corn fodder	42	Tons	311	7.49	7.00	2,177	52.46
Small fruits	1.25	Pounds	1,254	1,003.20	.04	50	40.13
Garden	199					11,386	57.36
Hay, except above	173	Tons	230	1.33	7.00	1,610	9.31
Oats	5,199	Bushels	132,734	25.53	.50	66,367	12.77
Pasture	1,355					17,779	13.12
Peas	.25	Bushels	3.00	12.00	2.40	7	28.80
Potatoes	215	...do	31,272	145.28	.40	12,509	58.11
Wheat	2,943	...do	55,591	18.89	.75	41,693	14.17
Total cropped acre-acreage.	24,833	Total and average				410,031.00	16.51

Crop.	Area (acres).
Irrigated, no crop:	
Nonbearing orchard	189
Young alfalfa	1,410
Ground fall plowed	221
Miscellaneous	86
Less duplicated areas	986
Total irrigated acreage.	25,753

Areas.	Acres.	Farms.	Per cent of project.
Irrigable area farms reported	30,591.49	498	20.7
Irrigated area farms reported	25,753.00	498	17.4
Irrigated under water-right applications.	25,608.00	497	17.3
Irrigated under rental contracts	145.00	1	.1
Cropped area farms reported	24,833.00	498	16.8

PUBLIC NOTICES AND ORDERS.

PUBLIC NOTICE, SEPTEMBER 25, 1915.

1. Under the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof or supplementary thereto, particularly section 4 of the reclamation extension act of August 13, 1914 (38 Stat., 686), it appears that a majority of the

water-right applicants and entrymen in the Garland division of the Shoshone project have made agreements providing for an increase in the cost of construction in the sum of $7 for the construction of drainage works. The said agreements are herey ratified and the said increase in the construction charge is hereby made effective in accordance with the conditions of the said contract, as follows:

2. The construction charge of all water-right applicants and entrymen in the Garland division of the Shoshone project who have accepted the terms of the reclamation extension act shall be increased $7 per irrigable acre.

3. The said increase of $7 per acre shall be paid in additional annual installments after the expiration of the 20 installments payable under the reclamation extension act, being in the case of each individual equal to the largest of the annual installments theretofore paid under his water-right application; but the final installment may be less than that amount if equal to the balance of the charge then due.

4. The said increased charge and conditions of payment shall apply to all land within the Garland division of the Shoshone project now or hereafter becoming subject to the terms of the reclamation extension act whether described in water-right applications heretofore or hereafter made.

5. All lands within the Garland division of the Shoshone project for which acceptances of the reclamation extension act have not been duly filed shall be charged with their proportion of the cost of these works, namely $7 per irrigable acre, and payments shall be made by the addition to the annual operation and maintenance charge of 70 cents per irrigable acre for 10 years, beginning with the charge due March 1, 1917.

A. A. Jones,
First Assistant Secretary of the Interior.

ORDER, OCTOBER 9, 1915.

1. Whereas section 10 of the act of Congress approved August 13, 1914 (38 Stat., 686), provides "that no entry shall be hereafter made and no entryman shall be permitted to go upon lands reserved for irrigation purposes until the Secretary of the Interior shall have established the unit of acreage per entry and water is ready to be delivered for the land in such unit or some part thereof and such fact has been announced by the Secretary of the Interior."

2. Therefore, pending the further development of the Shoshone project and the issuance of public notice in connection therewith pursuant to section 4 of the reclamation act of June 17, 1902, announcement is hereby made that water is available and entry may be made on and after October 25, 1915, at 9 o'clock a. m., at the local land office, Lander, Wyo., under the provisions of the reclamation law, and particularly the terms of section 10 of the reclamation extension act of August 13, 1914 (38 Stat., 686), for the unentered farm units shown as within the fifth unit on the following farm unit plats, viz:

Sixth principal meridian.—T. 55 N., R. 99 W.; T. 56 N., R. 99 W.

3. Warning is hereby expressly given that no person will be permitted to gain or exercise any right whatever under any settlement or occupation begun prior to 9 a. m. October 25, 1915, on any lands shown on said plats; *Provided, however*, That this shall not interfere with any valid existing rights obtained by settlement or entry while the land was subject thereto. All persons desiring to acquire any public lands shown on said plats shall execute homestead application subject to the provisions of the reclamation act in the manner required by law, which, with the required fees and commissions, shall be presented to the local land office at Lander, Wyo., in person, by mail, or otherwise within a period of five days prior to October 25, 1915—that is, beginning not earlier than October 20, 1915. All entries filed as herein provided and reaching the local land office not later than 9 a. m. on October 25, 1915, shall be held and treated as simultaneously filed. Applications presented after that hour will be received and noted in the order of filing. Any application not based on a prior settlement right will be subject to valid settlement claims asserted in the manner required by law.

4. The register and receiver will carefully compare all applications simultaneously filed as aforesaid and will dispose of them as follows:

(*a*) Where there is no conflict the application shall be allowed, irrespective of whether settlement is alleged.

(*b*) In case of conflicting applications and only one of the applicants alleges prior settlement, his application shall be allowed and the others rejected.

(*c*) If two or more conflicting applications are received, each containing allegations of prior settlement, a hearing shall be ordered to determine the priority of right, and it shall be restricted to those alleging such right.

5. Where there are applications conflicting in whole or in part in which no one of the several applicants claims prior settlement, the register and receiver will write on cards the names of the several applicants, and each of these cards shall be placed in an envelope upon which there is no distinctive or identifying mark, and at 2 o'clock p. m. on the date of opening to entry, if practicable (if not, at the same hour one week later), after all the envelopes containing the names of the several applicants shall have been thoroughly mixed in the presence of such persons as may desire to be present, they shall be drawn and numbered in order. The cards as numbered and drawn will be securely fastened to the applications of the respective persons, and the applications shall be allowed in such order. Where any applicant fails to obtain land applied for by him he will be permitted to elect whether he will amend his application to embrace other lands not affected by pending applications and otherwise subject thereto when such amended application is presented, or withdraw his original application without prejudice, and in the event of such withdrawal the fee and commissions will be returned by the receiver. Applications conflicting in whole with those previously allowed will be rejected in the usual manner.

6. The limit of area per entry representing the acreage which, in the opinion of the Secretary of the Interior, may be reasonably

required for the support of a family upon such lands is fixed at the amounts shown upon the plats for the several farm units.

7. The said lands shall be subject to a water service charge which shall consist of the operation and maintenance charges applicable to other lands under the Shoshone project with 10 per cent added thereto, and the said charge shall be subject to the terms and conditions applicable to the operation and maintenance charges for the said project.

8. No employee of the Reclamation Service nor any person who served in any capacity in connection with the survey of these lands or the preparation of the farm unit plats thereof shall be permitted to make entry of any farm unit shown on the said plats until further notice.

FRANKLIN K. LANE,
Secretary of the Interior.

PUBLIC NOTICE, JUNE 3, 1916.

1. In pursuance of the provisions of the reclamation act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, and in particular the reclamation extension act of August 13, 1914 (38 Stat., 686), section 6 of which authorizes the Secretary of the Interior to fix the due date for operation and maintenance charges, notice is hereby given that hereafter until further notice for all lands under the Shoshone project, Wyoming, the operation and maintenance charges for any irrigation season shall be due and payable on March 1 of the following calendar year.

2. The operation and maintenance charges for the irrigation season of 1916 and for each irrigation season thereafter until further notice, except for lands within the fifth unit, which shall be 10 per cent more, as provided in paragraph 7 of public notice of October 9, 1915, shall be as follows, viz: Each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge of 70 cents, which will permit delivery of not more than 2 acre-feet of water per acre, and should further quantities be needed they will be furnished at the following rates, viz: For the next acre-foot per acre the rate shall be 15 cents per acre-foot, and for all additional water furnished the rate of charge shall be 25 cents per acre-foot. The charges for all additional water furnished shall be due and payable on December 1 after the close of the irrigation season.

3. The provisions of this public notice cover all lands subject to public notice heretofore issued for the said project.

4. Except as hereinabove provided, all the terms and provisions of existing public notices and orders, and in particular the public notice of March 1, 1915, for the Shoshone project, shall remain unchanged.

ANDRIEUS A. JONES,
First Assistant Secretary of the Interior.

FINANCIAL STATEMENT.

(Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 744.)

Feature costs of Shoshone project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys	$66,263.69	$66,263.69
Storage works:		
Preliminary and general work	268,977.42	
Shoshone dam and spillway	896,388.85	
Tunnels (permanent)	120,783.36	
Sluice gates	70,435.19	1,356,584.82
Canal system:		
Preliminary and general work	12,039.77	
Diversion dam and headworks	97,467.80	
Headworks (separate from dam)	57,687.95	
Tunnels	1,147,482.43	
Main canals	583,042.77	
Flumes	62,601.32	
Drops, chutes, and checks	107,782.91	2,068,104.95
Lateral system:		
Preliminary and general work	30,784.20	
Laterals and sublaterals	308,213.19	
Bridges	10,170.48	
Drops, chutes, and checks	6,094.27	
Siphons	2,270.87	
Wasteways	34,799.28	
Flumes	73.49	
Culverts	237.27	392,643.05
Drainage system:		
Preliminary and general work	22,516.41	
Open drains	75,827.70	
Closed drains	370,133.05	468,477.16
Farm units: Preliminary and general work	12,904.67	12,904.67
Permanent improvements and land:		
Buildings	11,359.48	
Roads	155,592.69	166,952.17
Telephone system: Telephone lines	10,901.87	10,901.87
Plant accounts	38,443.52	38,443.52
Operation and maintenance charges transferred to and compounded with the construction charges	147.75	147.75
Gross cost of construction of project to June 30, 1916		4,581,423.65
Less revenues earned during construction period:		
Rental of buildings	12,402.31	
Rental of grazing and farm lands	2,181.30	
Rental of telephones and tolls	145.75	
Contractors' freight refunds	19,355.59	
Forfeitures by defaulting contractors and bidders	34,860.08	
Sale of town-site lots	51,728.40	
Other revenues, unclassified	1,150.57	
Loss on mess-house operations	[1] 10,222.18	
Profit on mercantile store operations	3,252.00	
Profit on hospital fund operations	381.02	115,234.84
Net cost of construction of project to June 30, 1916		4,466,188.81

[1] Deduct.

Estimated cost of contemplated work, Shoshone project, during fiscal year 1917.

Features.	Sub-feature.	Principal feature.
Examination and surveys: Preliminary and general work	$8,000	$8,000
Canal system:		280,000
Main canal	80,000	
Tunnels, diversions, flumes, etc	200,000	
Lateral system:		150,000
Laterals and sublaterals	121,000	
Tunnels, flumes, bridges, etc	29,000	
Drainage system:		138,000
Open drains (3,000 linear feet)	3,000	
Closed drains (100,000 linear feet)	135,000	
Farm units: Preliminary and general work	10,000	10,000
Permanent improvements and land: Buildings	16,000	16,000
Telegraph system: Telephone lines	2,000	2,000
Operation and maintenance under public notice:		50,000
Operation	22,800	
Maintenance	27,200	
Messes	8,000	8,000
Mercantile stores	2,000	2,000
Hospital fund account	2,000	2,000
Total	666,000	666,000

SECONDARY PROJECTS.

By John T. Whistler, engineer, Denver, Colo.

ARIZONA.

COLORADO RIVER STORAGE.

See Colorado River Basin, page 514.

LITTLE COLORADO PROJECT.

Investigations on Little Colorado River have been referred to in the third annual report, pages 174 to 187, inclusive, and in subsequent annual reports.

A report was made on certain features of Little Colorado River investigations, dated September 17, 1905, by W. H. Sanders and B. M. Hall. Some further consideration was also given Little Colorado River projects by John F. Richardson, engineer, in 1915. It was the opinion of Mr. Richardson that the large percentage of silt carried by Little Colorado River entirely eliminated further consideration of Woodruff, Forks, and La Ruex reservoir sites, and also perhaps the Tucker site. It was also pointed out by Mr. Richardson that owing to the very erratic run-off of this stream any extensive irrigation development from it would require "hold-over" storage capacities in the reservoirs, possibly for several years, and that in such case the evaporation from their surfaces would be an important factor to be considered.

SAN CARLOS PROJECT.

Referred to in the first and subsequent annual reports. No recent work has been done.

SAN PEDRO PROJECT.

Referred to in the second and subsequent annual reports. No recent work has been done.

CALIFORNIA.

COLORADO RIVER STORAGE.

See Colorado River Basin, page 514.

HONEY LAKE PROJECT.

This project was referred to in the second annual report. It lies on the east side of the Sierra Nevada Range, near the California-Nevada State line, in Lassen County. It has attracted irrigation investigators for many years. A report on the project, to Honey Lake Valley Land & Water Co., was made in 1891 by L. H. Taylor, subsequently project engineer on the Truckee-Carson project, Nevada; it was reported upon again by William Ham Hall in 1896. The project lies in the Great Basin. Honey Lake Valley is a western arm of the Quaternary Lake Lahontan. Neither Honey Lake nor Eagle Lake, which is considered in connection with the project, has an outlet, and the lake surfaces are determined by the relation of evaporation to stream discharge into the lakes. The total discharge into Honey Lake is approximately 200,000 acre-feet, and into Eagle Lake 90,000 acre-feet.

Early in 1915 certain landowners and residents of Lassen County, who had taken preliminary steps toward the organization of an irrigation district, petitioned the Department of the Interior to cooperate with them in making further investigations as to the feasibility of the project. On March 18, 1915, at Reno, Nev., the proposal of the interested landowners of Honey Lake Valley was discussed with E. G. Hopson, supervising engineer. An agreement was drawn up on this date between the Reclamation Service and the Southern Lassen Irrigation Association, represented by Leonard F. Dozier, president, and John F. Mauck, secretary, providing for equal contribution by the parties to the contact to a fund of not to exceed $5,000. This agreement was subsequently approved.

Under this contract investigations were begun during the latter part of April and continued to July following. The field work was done by Mr. G. Stubblefield, together with S. T. Harding, assistant professor of irrigation, University of California, who cooperated in a soils survey of the irrigable lands. A general report on the project was prepared by Mr. Hopson and was accompanied by separate reports by Mr. Stubblefield and Prof. Harding.

The Southern Lassen Irrigation Association failed to keep its agreement as to contribution of half the expense of the investigation, and the only money received on their account was $500, which had been subscribed by Lassen County. Only sufficient work was done, therefore, to make available to the Reclamation Service the data obtained, and the report was not published.

The project proposed is to lower the level of Eagle Lake 50 feet by means of a tunnel about 14,000 feet long discharging into Willow Creek, a tributary of Susan Creek and Honey Lake. This will reduce the evaporating surface of Eagle Lake to such an extent that, together with other minor storages considered on upper Susan Creek, a water supply for an area of about 25,000 acres in Susan Creek and Honey Lake Valleys, additional to that already irrigated, may be developed. The estimated cost, considering a possible credit for lands which may be reclaimed about Eagle Lake, is from $34 to $50 per acre. In addition to this it is estimated that an average of $30 per acre will be required to prepare the lands for irrigation. A possible future development of as much as 30,000 acres more may be considered by pumping, but at a cost, including operation of pumping plant, which is regarded as prohibitive at this time.

No water-power development was considered in connection with the project, other than a proposed head of about 70 feet at the tunnel outlet, which might be used for pumping from Honey Lake at such time in the future as the value of the land would justify it.

IMPERIAL VALLEY PROJECT.

Referred to in the fourth annual report only. No work has been done since.

IRON CANYON PROJECT.

Referred to in the fourteenth annual report. Prior to this time reference was made to it under Sacramento Valley projects.

This project has been under consideration by the Reclamation Service for a number of years; a preliminary investigation was made in 1904 and 1905 of storage reservoirs to be used in connection with it. In 1909 investigations by the service were again taken up, but were not completed. The results and conclusions reached at that time were embodied in a report published by the United States Senate Committee on Irrigation and Reclamation of Arid Lands, Sixty-first Congress, third session. It was proposed in this project to provide at Iron Canyon a reservoir having a maximum capacity of about 260,000 acre-feet, of which approximately 150,000 acre-feet only would be at an elevation available for irrigation use under the proposed plan. This storage, however, was to be supplemented by a reservoir on upper Pit River, in Big Valley. The irrigable area of the project under this plan was approximately 100,000 acres.

No diamond drill borings had been made at the dam site for determination of character of foundation. In the summer of 1913 certain citizens of Sacramento Valley again took up the matter, urging further investigations for a more definite estimate, and at this time it was proposed to increase the height of dam considered, to provide storage for a larger area. An agreement was entered into October 6, 1913, between E. G. Hopson, supervising engineer, representing the Department of the Interior, and Judge J. F. Ellison and others, representing the Iron Canyon Project Association, by which $10,000 was provided by each party to the contract for further investigations. The field work and studies for these investigations were made under the direction of John T. Whistler, engineer, and the report itself prepared by E. G. Hopson, supervising engineer.

The results of these investigations appear in a published report, under Cooperative Investigations in California, November, 1914. The project proposed in this report contemplated the irrigation of as much as 300,000 acres of land in upper Sacramento Valley. Flooded areas and capacities of Iron Canyon Reservoir proposed are as follows:

Elevation.	Flooded area (acres).	Storage (in acre-feet).	Elevation.	Flooded area (acres).	Storage (in acre-feet).
260	29	0	340	4,250	106,000
270	108	1,000	350	6,005	156,000
280	292	3,000	360	9,030	231,000
290	619	7,000	370	12,185	337,000
300	947	15,000	380	15,830	476,000
310	1,383	26,000	390	20,280	656,000
320	2,029	43,000	392.5	21,570	709,000
330	3,165	69,000	400	26,175	887,000

The possible water-power development in connection with the project is approximately 50,000 horsepower. The estimated cost per acre irrigated varies from $37 to $73 for the various alternatives, depending in part on certain assumed values to be given for water-power development.

LOWER PIT RIVER PROJECT.

As a further result of the Iron Canyon project investigations in 1913 and 1914, a project to divert water from lower Pit River to about 55,000 acres of land east and northeast of the city of Redding was proposed by the interests above Iron Canyon. Under date of September 10, 1914, a contract was entered into between the Reclamation Service, represented by E. G. Hopson, supervising engineer, and The Northern California Irrigation Association, through its president, M. T. Howell, and secretary, Roscoe J. Anderson, representing interests in and in the vicinity of Shasta County. The contract provided that the expense of the investigation should not exceed $5,000, the cost to be borne equally by the parties to the contract. Reference is made to this investigation in the fourteenth annual report.

In 1913 and in the spring of 1914 the plan of taking water from Pit River by means of a high diverting dam and tunnel piercing the ridge that divides Pit River Basin from those of the small eastern tributary streams of the Sacramento lying immediately to the south was worked into a definite proposition, and a preliminary estimate made by private engineers for the interested parties of Shasta County. The plan proposed contemplated the development of storage on upper Pit River to supplement the low water flow of that stream in order that diversions for irrigation might not diminish the low water flow of Sacramento River, which is still held open to navigation as far as Red Bluff.

The investigations under the contract were limited generally to studies of data already made available by the surveys mentioned, to a soil survey of the irrigable area proposed, and to brief investigations of certain storage sites which had been suggested on several of the small streams discharging into Sacramento River below Redding. The soil survey and other field work, together with the conclusions reached as a result of the soil survey, were made by Thomas H. Means, engineer, of San Francisco.

Briefly, the project proposed as a result of the investigations includes a diversion dam on Pit River, about 8 miles above the mouth, raising the water 126 feet, a tunnel 13,000 feet long through the ridge separating the Pit River Basin from the Sacramento Basin proper, and main canal with distributing system to the area on the east side of Sacramento River, extending from the vicinity of Redding to and including Cow Creek Valley. Since the low water flow of Pit River at the proposed diversion is several times the amount required for irrigation of the area proposed, the storage is required only to supplement the short period of low water in Sacramento River as affecting navigation interests. A storage site for this purpose on South Fork of Cow Creek was suggested, in which a storage of 15,000 acre-feet would be provided by a dam approximately 100 feet high. Another site offering possibilities is located just above the junction of the two forks of Cow Creek, but it is pointed out that the elevation of this supply would be too low to be fully utilized directly by the lands under the project.

The estimated cost of construction, exclusive of storage, is $3,417,000 for 55,000 acres, or $62.13 per acre.

At the diversion dam proposed, since the minimum flow of Pit River is more than four times the maximum requirement for the project, it will be possible to develop hydroelectric power from a minimum of over 2,000 second-feet with a fall of 128 feet, or approximately 23,000 continuous horsepower at the power-house switchboard. The control and regulation of the discharge of Pit River through the large pondage above the diversion dam will make it practicable to take care of almost any variable load that the market may demand. On a basis of 50 per cent load factor the practicable power development would be 46,000 horsepower.

The conclusions reached in the report are:

That the project is not feasible as a private enterprise by reason of the diverse character of the ownership and the heavy initial investment necessary.

That the project, if found feasible after more detailed examination, must necessarily be built by the Government, the State, or possibly one or both of them acting in cooperation with the landowners.

That it will be necessary to include in the construction operations carried out by the central administrative organization not only the irrigation system, but the clearing of the land and its preparation for water.

Report on these investigations has been published as lower Pit River project, under Cooperative Investigations in California, July, 1915.

OWENS VALLEY PROJECT.

Referred to in the first and subsequent annual reports. No recent work has been done.

PIT RIVER BASIN.

Considerable attention had been given in the early years of the service to storage possibilities in Sacramento River drainage basin other than the proposed Iron Canyon Reservoir. (See fifth annual report, Sacramento Valley Investigations, pp. 94 to 98, inclusive, and previous reports.) Pit River Basin appeared to offer several more or less attractive storage possibilities, and early in 1914, following field investigations for Iron Canyon project, report on which was published, it was proposed to take up again and extend the investigations of the storage possibilities in Pit River Basin. (See fourteenth annual report.) It was felt by the people above Iron Canyon that the use of Iron Canyon reservoir site would be of no benefit to them, and by many it was felt that it would be an actual injury. The purpose, therefore, of the Pit River Basin investigations at that time was to present in a published report similar to that for the Iron Canyon project the possibility of storage on Pit River, to the end that if it should prove as feasible or practicable as the Iron Cayon storage it might be adopted as the development policy instead of the Iron Canyon project.

The investigations were made in cooperation with the State of California through the department of engineering, W. F. McClure, State engineer. One-half the expense was to be borne by the State of California, the maximum to be expended by either party being $2,500. An agreement covering this cooperative work was executed under date of May 27, 1914. The contract was executed on the part of the United States by E. G. Hopson, supervising engineer, under whom, assisted by O. W. Peterson, the investigations were made.

The conclusions from the investigations were:

That in the Pit River Basin there are about 180,000 acres of potentially fertile, irrigable land, of which about 40 per cent is now fully or partially irrigated.

That of the areas now irrigated only an insignificant proportion is well developed agriculturally, due in large part to unregulated water supplies and to unsatisfactory drainage conditions.

That Jess Valley and Round Valley offer the most favorable sites for the development of storage for use on lands in the Pit Basin. There is good reason to expect that the cost of irrigation development under these sites will be in keeping with the expense usually incurred for similar and successful enterprises.

That lands in Fall River Valley can be advantageously irrigated by pumping, the supply being practically inexhaustible.

That lands adjacent to and in the vicinity of Hat Creek that are not yet irrigated can be readily irrigated by direct diversion without storage. These lands are, however, mostly timbered, and their development is not a matter for immediate consideration.

That there are a number of small irrigation developments possible in various localities, but that none of these involves large engineering problems.

That Willow Creek, in the Klamath Basin, may be a possible supplementary source of supply for lands in Big Valley, but this can only be ascertained by extended observation of the run-off of the creek and by careful surveys and estimates of cost.

That under conditions of to-day Goose Lake is an impracticable source of water supply for territory in or below the Pit River Basin.

That irrigation development in the Pit River Basin will not seriously interfere with future power development in or below the basin.

That irrigation development in the Pit River Basin will reduce the low-water flow of the Sacramento River at Red Bluff only about 8 per cent, and will not, therefore, seriously interfere with the navigability of the river.

That floods in the Sacramento River can not be controlled by storage in the Pit River Basin.

It was also recommended—

That no future appropriations of water for power or other purposes in the Pit River Basin that will tend to retard or limit irrigation development in the basin be allowed by the State of California.

That measurements of stream flow of South Fork of Pit River near Jess Valley dam site and on Ash Creek at Adin should be resumed by the United States and the State of California.

Following is a tabulation of storage capacities of Jess Valley and Round Valley Reservoir sites at various elevations:

Jess Valley reservoir site.

Height of water level above plane at dam.	Elevation of water surface, assumed datum.	Area flooded.	Storage.
Feet.	*Feet.*	*Acres.*	*Acre-feet.*
0	100	0	0
2	110	810	810
12	120	1,730	13,500
22	130	2,160	33,000
32	140	2,460	56,000
42	150	2,700	81,000
52	160	2,880	110,000

Round Valley reservoir site.

Height of water level.	Area.	Total capacity.	Height of water level.	Area.	Total capacity.
Feet.	*Acres.*	*Acre-feet.*	*Feet.*	*Acres.*	*Acre-feet.*
0	0	0	50	1,430	25,200
10	65	218	60	2,060	42,700
20	304	2,060	70	2,860	67,300
30	528	6,220	80	3,560	99,400
40	918	13,500			

The estimated cost of providing 40,000 acre-feet net annual supply at Jess Valley reservoir site is $208,000, or approximately $5.20 per acre-foot. The estimated cost of 47,000 acre-feet annual net supply at Round Valley is $335,000, or $7.13 per acre-foot.

The investigations did not cover power possibilities except as incidental to or affected by proposed irrigation, though attention was called in the report to the power possibilities on Pit River below Fall River.

Report on Pit River Basin, as a result of these investigations, was published by the Reclamation Service office at Portland, Oreg., April, 1915, and printed by the California State Printing Office.

SACRAMENTO VALLEY PROJECT.

Referred to in the first and subsequent annual reports. No recent work has been done.

SAN JOAQUIN PROJECT.

Referred to in the fourth and subsequent annual reports. No recent work has been done.

SHASTA VALLEY PROJECT.

Referred to in the fourth annual report. No work has been done since.

COLORADO.

COLORADO RIVER BASIN.

Investigations in Colorado River Basin looking to the probable necessity for storage in the upper basin for lower Colorado River lands and Imperial Valley in California and Mexico have been carried on from time to time since the first year of the Reclamation Service, and earlier by some of the other bureaus of the Government. References to these investigations appear in the first and subsequent annual reports, under Arizona, California, and Colorado, being generally referred to as "Colorado River Storage Investigations."

Among the first investigations were those of Kremmling Reservoir site, in the upper basin, and irrigable land areas along the lower river below Bulls Head Canyon above old Fort Mojave. Reference is made to these investigations in more or less detail in the second, third, and fourth annual reports, together with investigations of Windy Gap, Lehman, and Grand Lake reservoir sites in Colorado.

Flaming Gorge, Island Park, and Browns Park reservoir sites, on Green River in northwestern Colorado, northeastern Utah, and southern Wyoming, have been referred to in the seventh annual report. Further reference to work done at Browns Park reservoir site during the years 1907, 1908, and 1909 may be found in the ninth annual report.

Little more was done in investigation of Colorado River Basin until July, 1914, when work was again actively taken up. Brief reference to this is found in the fourteenth annual report. The investigations of 1914 and 1915 were under the direction of John F. Richardson, engineer. The principal projects or features investigated were: Junction reservoir site, Utah, at junction of Grand and Green Rivers; Flaming Gorge Reservoir site, Utah-Wyo.; Juniper Reservoir site, on Yampa (Bear) River, Colo.; and investigations in cooperation with the State of Wyoming as to irrigable areas within Colorado River Basin in Wyoming, and storage sites.

Junction reservoir site.—A topographic survey of the junction for a few miles up Grand River, a mile up Green River, and nearly 2 miles down the Colorado below the junction was made on a scale of 200 feet to the inch to determine the best apparent location for a dam. A rapid survey of the Green River branch of the reservoir site was made on a scale of 1,000 feet to the inch; for the Grand River branch of the reservoir site a previous river profile survey by the United States Geological Survey was used. The approximate storage capacities for Junction reservoir site are as follows:

Contour.	Area (acres).	Capacity (acre-feet).	Contour.	Area (acres).	Capacity (acre-feet).
3880	0	0	4025	30,160	2,091,000
3900	219	2,190	4050	35,460	2,911,000
3925	8,270	108,300	4075	46,260	3,933,000
3950	13,100	375,400	4100	57,050	5,224,000
3975	21,470	807,500	4125	66,530	6,769,000
4000	25,520	1,395,000	4150	76,390	8,555,000

Diamond drill work at Junction dam site was begun in August, the drill being hauled down from Green River, Utah, 25 miles, to Wimmer's ranch, from which point it was taken down the river on scows. On August 29 the first hole had reached a depth of 90 feet, encountering nothing but river sand; there being no more drill rods on hand, hole No. 2 was started, and on September 16 a depth of 124.5 feet had been reached, 50 feet of which was river sand and the remainder sand and sandstone bowlders. On September 30 hole No.

3, about 325 feet downstream, had reached a depth of 120 feet in bowlders and sand, at which point a piece of casing broke off, lodging crosswise of the hole, and the drill was then moved to hole No. 4, approximately a quarter of a mile below the junction. On October 3 rock, probably a bowlder, was encountered at 101.5 feet depth. By shooting it was penetrated 0.4 foot that day. On the following day the river suddenly rose nearly 8 feet and the drift, notwithstanding the efforts of the men to hold the scows, snapped the cables and broke off the casing and rods in the hole. The drill was saved, and several days spent trying to recover the rods and casing, which proved impossible. Further drill work was then abandoned.

This dam site has been referred to as Wilson Rock dam site, and the reservoir site sometimes as Wilson Rock Reservoir site.

Flaming Gorge Reservoir site.—After reconnoissance by Mr. Richardson and others, diamond-drill investigations at Horseshoe Canyon were approved for this reservoir site and actual drill work begun early in November and continued all winter, being completed early in April. Twenty-five holes altogether were put down, 15 at what is referred to as the upper site, 6 at the lower site, and 4 along the auxiliary dam site or spillway site. Penetration into bedrock was carried to a depth of as much as 100 feet. At the upper site seven river holes were drilled and bedrock encountered at depths varying from 36 to 73 feet below elevation of low water. Of the two sites the upper shows the better bedrock conditions. At the auxiliary dam site, or suggested spillway site, rock outcrops in the middle of the depression. On one side of this clay and bowlders are encountered for a depth of 20 to 26 feet, followed by sandstone of rather poor quality; on the other side a sandy clay is encountered from 6 to 13 feet thick, underlaid by a sandy shale. The shale, however, is quite hard, making a good core.

Topographic survey of the site had been made during the summer and fall of 1914 by R. B. Worthy, topographer. Areas flooded and capacities are as follows:

Contour.	Area (acres).	Capacity (acre-feet).	Contour.	Area (acres).	Capacity (acre-feet).
5825	0	0	5975	20,613	1,351,400
5850	2,195	27,440	6000	25,457	1,927,280
5875	5,394	122,300	6025	30,629	2,628,350
5900	7,672	285,630	6050	37,214	3,476,390
5925	12,153	533,470	6075	45,026	4,504,340
5950	16,333	889,570			

Daily silt samples were taken at Horseshoe Canyon April 5 to 28, 1915. These samples were taken and the silt determinations made in the usual manner. Of the total 2,400 cubic centimeters of water collected, the accumulated volume of submerged silt was 11 cubic centimeters, the weight of which, when dried to constant weight at 120° C., was 1.775 grams. For this period, therefore, the silt content by weight as estimated by Mr. Richardson was 740 parts per million of water, and the computed weight per cubic foot of the submerged silt as measured was 10 pounds.

Juniper Reservoir site.—Early investigations had suggested possible storage sites on Yampa (Bear) River, particularly a reconnoissance by Oro McDermith, engineering aid, in 1904, referred to in the third annual report, page 71. The dam site for this reservoir is near the east line of sec. 18, T. 6 N., R. 94 W., sixth principal meridian.

Further reconnoissance examinations were made by John F. Richardson, engineer, in 1914, and in April, 1915, a topographic survey was begun of Juniper Reservoir site on a scale of 1 inch to 2,000 feet. Detailed surveys were made of the dam site on a scale of 1 inch to 100 feet.

Following diamond drill investigations at Horseshoe Canyon for Flaming Gorge Reservoir, diamond-drill work was begun at the Juniper site. The topographic surveys were completed the latter part of May, and diamond-drill work at dam site at the end of June. Three drill holes showed depths to bedrock of 17, 13, and 23 feet; the drilling in each hole was continued approximately a hundred feet into bedrock.

Following is tabulation of areas and capacities of Juniper reservoir site:

Contour.	Area (acres).	Capacity (acre-feet).	Contour.	Area (acres).	Capacity (acre-feet).
5950	0	0	6075	8,475	496,500
5975	780	9,800	6100	11,915	754,700
6000	2,925	56,100	6125	15,420	1,096,400
6025	4,965	154,700	6150	20,930	1,550,800
6050	6,815	302,000			

Silt samples were taken at this site May 14 to June 30, 1915, in the usual manner. The total volume of samples taken was 4,800 cubic centimeters; the total amount of sediment was 1.40 cubic centimeters. The weight was 0.487 gram when dried to 110° C. As computed by Mr. Richardson, this was equivalent to 101.5 parts per million of water by weight. The weight per cubic foot of sediment as measured was 21.75 pounds.

Only very preliminary estimates of cost of dam and reservoir have been prepared, since the character of dam and amount of storage required can be determined only after consideration of the storage questions involved for the entire basin.

Other storage sites.—Reconnoissance examinations were made by Charles B. Smith, reporting to Mr. Richardson, of the San Juan River from Navajo Creek in Colorado to Mexican Hat in southern Utah; Animas River from Durango, Colo., to its mouth at Farmington, N. Mex.; the La Plata River from Red Mesa to its junction with the San Juan River; and also minor examinations on Los Pinos River and the Piedra, both tributaries of the San Juan River. The large area of irrigable land and the excellent climate on the San Juan River, particularly below Arboles, Colo., together with the large run-off of the river, make it an attractive field for irrigation investigations. The river, however, is subject to very high flood discharges and low minimum discharges; any irrigation in this section will therefore involve storage. For a project of 125,000 acres it is estimated by Mr. Smith that a storage of approximately 200,000 acre-feet will be required for the extreme low years. The investigations developed no reservoir sites of apparent merit between Bloomfield and Navajo Creek. Any portion of the river between Bloomfield and Arboles would make a fair reservoir site, but no suitable dam site appeared to be available. Probably as good a dam site as any on this section of the river is that known as the Turley site, but it is not regarded as attractive by Mr. Smith and was reported upon decidedly adversely by F. L. Sellew, engineer.

No exhaustive investigation for storage possibilities on the San Juan River has been made, and it is recommended by Mr. Smith in his report as a matter that would probably require the work of an entire field party for a season.

Conditions on the Animas River are reported similar to those on the San Juan River, any further development requiring storage for the low-water period of the year. An early investigation of possibilities from the Animas and La Plata Rivers was made by M. C. Hinderlider in 1904 and 1905. Reference to it may be found in the third annual report, pages 392 to 394, under "Investigations in New Mexico." A project of 90,000 acres known as the Overland project was investigated. The estimated storage required for this project was approximately 110,000 acre-feet. In general, this project and the storage proposed coincide with that proposed by Mr. Hinderlider, referred to in the third annual report.

A preliminary survey of Bluff reservoir site, on San Juan River, about 12 miles below Bluff City, Utah, was made in September and October, 1914, by R. M. Priest, under the direction of F. L. Sellew, engineer. In a report by Mr. Sellew to F. W. Hanna, supervising engineer, January 23, 1915, the reservoir is thus described:

> A reservoir with a 200-foot dam has a capacity of 1,600,000 acre-feet, an area of 20,300 acres, and a length of lake of about 29 miles. With a 250-foot dam storage would exceed 2,000,000 acre-feet. Bedrock, which appears to outcrop at the dam site, is a hard red sandstone stratified with limestone.

The feasibility of the site as reported by Mr. Sellew depended, first, on the run-off, information as to which was limited; second, on the volume of sediment carried by the stream; and, third, the character of foundation for dam. It is probable that the run-off alone is sufficient to justify examination as to foundation for dam. Silt samples were taken from October 18, 1914, to August 2, 1915. These observations showed the suspended matter, silt, by weight, to be 5,110 parts per million of water discharged. For purpose of comparison, the suspended matter in parts per million, by weight, of San Juan River at Bluff and other points in the Colorado River Basin are given:

San Juan River at Bluff, Utah	5,110
Colorado River at Yuma, Ariz	3,000
Green River at Jensen, Utah	1,308
Grand River at Palisade, Colo	446
Grand River at Kremmling, Colo	148
Green River at Green River, Wyo	98

It would appear from this comparison that the San Juan River at Bluff carries more silt than the Colorado at Yuma. John F. Richardson, engineer, who visited the site and reviewed the information obtained, states that his observation at the mouth of the San Juan, where the difference in turbidity between the Colorado and the San Juan is apparent, leads him to believe that the San

Juan carried a larger percentage of suspended matter than the Colorado at Yuma. He points out that if the reservoir were built for 2,000,000 acre-feet capacity and all the suspended matter caught in the reservoir, without taking into account the question of heavy sand that rolls on the bottom, the complete life of the reservoir would be less than 100 years, and that the value of the reservoir for storage purposes would be reduced materially long before it would be completely filled with silt. It is his opinion that the effective life of the reservoir would be not over 75 years, and that, as various desilting schemes proposed can not be said to have been approved by engineers generally, and because of the probable high cost of the dam on account of its location, he does not consider the reservoir as feasible at this time.

Investigations were also made by Mr. Priest during the latter part of 1914 and the fore part of 1915 on Grand River and its tributaries, including Dolores River. As a possible reservoir was indicated on the Dolores at Bedrock, above Paradox Valley, about 70 miles above the mouth of the river, a topographic survey was made on a scale of a half mile to the inch and detail topography for dam site through about a mile and a half of the canyon on a scale of 100 feet to the inch. This site has been referred to as Bedrock Reservoir site, from a town of that name in the valley 3 or 4 miles above the dam site.

Computations from the surveys show that with a dam 250 feet high the flow line would extend about 33 miles upstream, cover 12,700 acres, and provide a storage capacity of 1,300,000 acre-feet. The dam, which would be 3 miles above the junction of the Dolores with the San Miguel, would have a top length of 1,600 feet and bottom length of 150 feet. The mean run-off of Dolores River at this point is probably about 400,000 acre-feet. It was the opinion of Mr. Sellew that the great length of the dam and the amount of sediment make the creation of storage here inadvisable.

Immediately following investigation of the Bedrock site, another site, a short distance below the town of Dolores, Colo., was surveyed. It was found that with a dam 250 feet in height the storage capacity at this point would be 315,000 acre-feet. The dam itself would be 1,800 feet long on top and 300 feet long at the bottom. Mr. Sellew reported that the river at this point is comparatively clear most of the time, but that the small storage capacity and extreme length of the dam made further consideration of the site inadvisable.

Attention was called in this report to the fact that at present the Montezuma Irrigation Co. is diverting approximately 150 second-feet of water across the low divide between the Dolores and the San Juan Rivers, and that it would be possible to divert the entire Dolores River into the San Juan watershed, but that the canal construction would be very expensive, due to the many ravines which would have to be crossed.

Reconnoissance investigations of Cross Mountain and Lily Park reservoir sites on Yampa (Bear) River were made in June, 1915, by K. Sawyer. Cross Mountain dam site is at the head of Cross Mountain Canyon, immediately below Maybell Valley and about 23 miles below Juniper dam site; there is a fall of approximately 116 feet between the two sites. Maybell Valley is quite thickly settled and well cultivated. About 17 miles below Cross Mountain dam site Yampa Canyon proper begins. Lily Park dam site referred to is at the head of Yampa Canyon. The fall of the river between Cross Mountain and Lily Park dam sites is between 175 and 200 feet. It is evident, therefore, that a reservoir created by a dam at the latter site would not have the storage capacity of one created by a dam at Cross Mountain site. The only advantage the Lily Park site would have is that it is below the mouth of Little Snake River; this may, however, not be an advantage, as this stream is known to carry a large amount of silt. Topographic surveys of the Cross Mountain site, with diamond drill investigations of dam site, might show it to be more feasible than the Juniper site, but because of the large area of cultivated land which would be submerged by a reservoir at the former site it has been estimated that the Juniper site will be the preferable one.

See also Wyoming Cooperative Work, page 543.

LOWER COLORADO RIVER PROJECT.

The irrigable land areas of lower Colorado River have been referred to in the fourth annual report under "Imperial Valley." In connection with the recent studies of Colorado River Basin, as a whole, a compilation of existing data relating to Imperial Valley, Yuma project, and other areas irrigable from lower Colorado River, together with water uses and requirements of these areas, is being prepared by L. M. Lawson, project manager of Yuma project. Mr. Lawson is being assisted by N. B. Conway, who has been connected with the development of Imperial Valley and with the flood water problems of the lower Colorado River for a number of years.

SAN LUIS VALLEY PROJECT.

This valley, including San Luis Park, is in south-central Colorado, near the State line, and constitutes the first main valley on the headwaters of the Rio Grande. The principal town within the valley and project considered is Alamosa, other towns being Del Norte, Conejos, and Saguache. Work was first taken up in this valley by James A. French, engineer, under instructions dated May 23, 1910. The principal purpose, of the earlier investigations at least, was to determine or obtain data from which an estimate might be made of the present and probable future irrigation in the valley as affecting the water supply of the Rio Grande and the Rio Grande project. Work during the summer of 1910 consisted of measuring the headgates and obtaining dimensions of measuring boxes and ditches of the valley, some 750 in number. Additional data were obtained from court records and the State engineer's office of some 900 additional ditches within the Rio Grande drainage above the lower end of the valley; also information as to storage possibilities for some 90 reservoirs and power schemes involving storage.

San Luis Valley is described quite fully in Water-Supply Paper 240, by C. E. Siebenthal, pages 9 to 54. The valley, or park, is 150 miles long from north to south, and about 50 miles in its greatest width.

It had been found by the International (Water) Boundary Commission that the Rio Grande at El Paso showed a decreased flow, beginning back as early as 1888, due to the uses of water in the upper

Rio Grande or San Luis Valley for irrigation. Mr. French found that 410 new ditches had been constructed in the valley since 1880, and that proposals had been made for storage to the extent of 1,500,000 acre-feet. He further concluded that 415,000 acre-feet more water was being used in 1895 than in 1880, 508,000 acre-feet more in 1903 than in 1895, and 186,000 acre-feet more in 1910 than in 1903.

The result of Mr. French's first year's investigations showed the net irrigable area in the valley to be over 1,400,000 acres, that 497,000 acres were then under actual irrigation, and that construction was in progress or proposed for 268,000 acres more.

Owing to the extensive area being irrigated in the valley and its relation to the international questions of Rio Grande waters involved, all reservoir sites on unpatented lands had been withdrawn from entry December 5, 1896, and instructions issued to deny right of way applications over such lands.

The investigations were continued by Mr. French until July 1, 1912, when the work was taken up by J. D. Stannard, engineer. In a report by Mr. Stannard in 1914 a general plan for the project was outlined, and the statement made that:

> Drainage of the San Luis Valley seems to be one of the most important problems facing the people of a large part of the valley at the present time.

Through petitions circulated in the valley during the winter of 1913–14 the attention of Secretary Lane had been directed to the project. As a result instructions were issued to Mr. Stannard to make such further studies and investigations as would enable him, in cooperation with D. G. Miller, drainage engineer of the Department of Agriculture, to prepare a full and complete report covering certain well-defined points.

The conditions and project proposed may be described briefly as follows. The area of the entire valley is something over a million and a half acres, with an estimated net irrigable area, as already stated, of approximately 1,400,000 acres. The very level character of the valley may be best described by quoting from the report by Messrs. Stannard and Miller, as follows:

> The size of the San Luis Valley is perhaps its most impressive feature; next its uniformly smooth surface impresses one as most remarkable. A railroad tangent 57 miles in length, requiring two hours or more for a train to pass over it; an irrigation ditch built on an east and west line for a distance of 23 miles are silent witnesses to each of these impressive features.

It is remarkable that approximately half the entire valley, from within 2 or 3 miles of the river, slopes away from the Rio Grande and has no outlet. The area of the so-called noncontributing drainage basin is approximately 2,800 square miles, while the area of the drainage basin of the Rio Grande itself at the point where it may be said to enter the valley proper is but 1,400 square miles, or half the area of the noncontributing basin, with a mean run-off of over 750,000 acre-feet. The elevation of the valley above sea level is from 7,500 to 8,000 feet. Owing to its comparatively low altitude and to the protection afforded by the broad mountain ranges around it, the climate is such as to make it a very successful agricultural region where diverse ground-water conditions do not prevent it. The State engineer for Colorado reports that the area in San Luis

Valley cultivated in 1914 was 510,000 acres. This included 229,000 acres of native grasses that were irrigated. It is estimated that a total of 650,000 acres in the northern end of the valley and 200,000 acres on the south side of the river would be benefited by drainage.

There were in 1914 over 6,000 flowing artesian wells in the San Luis Valley, of which over 4,000 were in the so-called noncontributing basin. These wells have an average discharge of about 40 gallons per minute.

The project proposed by Messrs. Stannard and Miller is to drain the now generally water-logged, noncontributing area by a large main drainage channel, to be constructed from the north end of the valley through the lowest part of the basin to San Luis Lake and thence on south to a junction with the Rio Grande some 8 miles below the town of Alamosa. For the first development it is proposed to construct that portion of this main drainage channel from San Luis Lake to the Rio Grande, thereby providing main drainage for about 300,000 acres.

The instructions to Messrs. Stannard and Miller were that they were to cooperate to the end that they be prepared with full and complete data to report:

(*a*) The anticipated approximate volume of water to be annually carried off by the contemplated canal and its probable quality.

(*b*) The approximate acreage that can be effectively drained into the said main drainage canal by a proper system of lateral drains.

(*c*) The extent to which it may be anticipated that installation of such canal will affect the general level of ground water in the valley.

(*d*) The approximate extent and cost of lateral drains necessary to accomplish the effective lowering of the ground water.

(*e*) The effect of such drainage upon the water from flowing wells of the valley.

(*f*) The approximate cost of such main drainage canal.

(*g*) The value of such drainage water for irrigation purposes.

(*h*) The general effect of the proposed drainage system upon the flow of the Rio Grande in New Mexico.

(*i*) The general effect of the proposed drainage system upon the agricultural resources of the valley.

In the summary of their report they state that it is not only feasible to construct a main drainage outlet from San Luis Lake to the Rio Grande, but that it is possible and practicable to enter the lake on a grade about 5 feet below the water surface as determined by surveys made by the United States Geological Survey during the autumn of 1914. Referring to the enumerated points in their instructions on which they were to report, they find:

(*a*) The anticipated approximate volume of water to be annually carried off by the contemplated canal is estimated to be not less than 300,000 acre-feet. Its quality offers no menace as a source of supply for irrigation.

(*b*) The approximate acreage that can be effectively drained into the said main drainage canal by a proper system of lateral drains is estimated to be not less than 300,000 acres.

(*c*) We may expect, under the conditions noted, that the general level of ground water will be lowered to approximately 5 to 5½ feet below the surface of the ground.

(*d*) Drains of sufficient size, located at a depth of 6½ to 7 feet, one-half mile apart, and mostly covered, may be installed at a cost of from $10 to $15 per acre and will probably be necessary to accomplish the effective lowering of the ground water.

(*e*) It is thought that such drainage will not have the slightest effect upon the flow of the artesian wells of the valley.

(*f*) It is estimated that the total cost of such main drainage canal will be from $320,700 to $360,480.

(*g*) It is estimated that its value will be many times greater than the cost above noted.

(*h*) The general effect will be to increase the flow of the Rio Grande by an amount equivalent to 260,000 acre-feet per annum, measured at the Elephant Butte Reservoir.

(*i*) Lands long idle will be brought under cultivation. Cultivated lands will increase in productivity, and millions will be added to the wealth produced in the valley.

In this summary reference is made only to that portion of the noncontributing area which will be drained by a canal from San Luis Lake to the Rio Grande. The extension of this drainage system to the north end of the valley is treated separately, with the estimate that such extension will add more than 1,850 square miles to the watershed of the Rio Grande, which combined with drainage will probably add an amount to the flow of the river equal to or exceeding the normal discharge of the Rio Grande at Del Norte.

WHITE RIVER PROJECT.

This project has been referred to in the first and subsequent annual reports. Somewhat extended reconnoissance surveys were made in 1903 and 1904 by Robert S. Stockton. Extracts from report on these investigations may be found in the second annual report, pages 201 to 206, inclusive, and in subsequent annual reports.

IDAHO.

DUBOIS PROJECT.

Reference is made to this project in the third and subsequent annual reports. No recent investigations have been made of the project.

KING HILL PROJECT.

This is a project taken up under the Carey Act which it is desired to have the Reclamation Service take over and complete. It is located principally on the south side of Snake River between Bliss and King Hill, on the opposite side of the river. The source of water supply is Malad Creek. The total area involved is approximately 15,000 acres. The project was partly constructed in 1908, and is now being partially operated.

A small amount of field work, necessary to consideration by the Reclamation Service, has been done during the month of June, and it is planned to have the project considered by a consulting board immediately following the work.

No estimates of cost are available.

PORT NEUF PROJECT.

Reference is made to this project in the fourth annual report and again in the eighth and subsequent annual reports. No recent work has been done in connection with this project.

MONTANA.

CLARKS FORK PROJECT.

This project is referred to in the fourth and subsequent annual reports. No recent investigations have been made.

CROW RESERVATION (INDIAN) PROJECT.

Referred to in the third and subsequent annual reports. No recent investigations have been made.

LAKE BASIN PROJECT.

This project is referred to in the fourth and subsequent annual reports. No recent investigations have been made.

MADISON RIVER PROJECT.

This project is referred to in the fourth and subsequent annual reports. No recent investigations have been made.

MARIAS PROJECT.

Referred to in the first and subsequent annual reports. In the earlier reports this project was considered in connection with the Milk River project, but is now treated as a separate secondary project.

Separate investigations were made for this project in 1904 and 1905. Reference to it at some length will be found in the third annual report, pages 306 and 307. It is more fully discussed in the fourth annual report, pages 185 to 188. Two Medicine, Marias, and Lonesome Reservoirs are described and capacities given in this latter report.

The data given in the third and fourth annual reports are reviewed briefly in the sixth annual report, pages 119 to 121. The project is referred to in subsequent reports as one of the secondary projects.

No recent work has been done on this project other than a short survey to delimit the boundary of Marias reservoir site through certain unpatented lands for restoration of that portion not affected by the proposed reservoir.

NEBRASKA.

PLATTE RIVER PROJECT, NEBRASKA COOPERATIVE WORK.

Investigations for this project were first taken up in 1914 in cooperation with the State of Nebraska. Reference is made to it in the thirteenth annual report, page 183, and in the fourteenth annual report, page 170. No further work has been done.

SOUTH PLATTE PROJECT.

Referred to in the fourth and subsequent annual reports. No recent work has been done.

NEVADA.

WALKER RIVER PROJECT.

This project is referred to in the fourth annual report, page 266, fifth annual report, pages 207 and 208, and in subsequent annual reports.

Further investigations of the project were made in 1915 by J. C. Stevens, reporting to E. G. Hopson, supervising engineer at Portland, Oreg. Following are extracts from the summary of report by Mr. Stevens:

The irrigable lands lie in five principal valleys, through which run the main Walker River and its east and west branches. On West Walker River are Antelope and Smith Valleys, on East Walker River is Bridgeport Valley, and on the main stream are Mason and Walker Lake Valleys.

No reclamation is proposed for the two upper valleys, namely, Bridgeport and Antelope.

A system of reservoirs and canals is proposed to irrigate a total of 109,700 acres in the three lower valleys, of which not over 28,000 acres have actually been irrigated.

Water rights in the basin have been adjudicated, but future economies of water consumption will demand a readjustment of the present system with substantial benefits to all parties concerned.

Total irrigable area in the basin, 265,630 acres.

Lands to which water rights have been decreed in the three lower valleys, 61,930 acres.

Lands actually irrigated in the three lower valleys in 1905, 30,120 acres.

West Walker River yields nearly twice as much water as East Walker River, the average for 12 years being for West Walker River 286,000 acre-feet and for East Walker 160,000 acre-feet.

The report contains all existing data on return waters. Mr. Stevens assumes the following for the different valleys:

Antelope Valley, 50 per cent of diversions.

Smith Valley, 35 per cent of diversions.

Southern end of Mason Valley, 25 per cent of diversions.

Remainder of Mason Valley, 15 per cent of diversions.

During the 12 years preceding the report there were 5 years in which there was no water shortage. The greatest deficiency occurred in 1912, when there was insufficient water to the extent of 70,000 acre-feet to supply the demand. The storage of 58,000 acre-feet on West Walker River would have supplied all deficiencies.

The works proposed are:

1. Storage reservoir in Antelope Valley, 200,000 acre-feet capacity.
2. Two main canals in Smith Valley, one on either side, with distributing system to cover 34,000 acres, of which 5,680 acres have been irrigated.
3. Two main canals in Mason Valley, one on either side, both heading below the junction of the river branches, with distributing sys-

tem to cover 65,000 acres of land, of which 20,760 acres have been irrigated.

4. A reservoir of 10,000 acre-feet capacity, to supplement the supply for Walker Lake Valley, to furnish water for 6,000 acres now under canal, of which but 900 acres have been irrigated; also at some later date improvement of canal on the west side to cover ultimately 10,700 acres.

5. A storage reservoir at Big Meadows, on East Walker River, of 45,000 acre-feet capacity. This will be for later development and may be found to be impracticable on closer study.

The cost of complete development is roughly estimated from such general data as are available to be $6,200,000, or $57 per acre, without interest charges.

NEW MEXICO.

LA PLATA PROJECT.

Reference is made to this project in the second and subsequent annual reports. Preliminary surveys in more or less detail were made on this project by M. C. Hinderlider in 1904–5. Reference to this investigation may be found in the third annual report, pages 392 to 394, and in the fourth annual report, pages 280 to 282. No recent work has been done on this project. See Colorado River Basin, Other Storage Sites, page 517, for reference to recent investigations.

LAS VEGAS PROJECT.

This project is referred to in the second and subsequent annual reports. It is treated at some length in the third annual report, pages 369 to 372. No recent work has been done.

URTON LAKE PROJECT.

Extracts from report by W. M. Reed appear in the second annual report, pages 387 to 389, together with recommendations by board of consulting engineers. Reference to this further work recommended is found in the third annual report, page 94. No further work has been done.

NORTH DAKOTA.

BISMARCK PROJECT.

This project is one of a group of pumping projects considered along Missouri River in North Dakota. It is referred to at some length in the third annual report, pages 442 to 444. No recent work has been done.

BOWMAN PROJECT.

This is a storage project lying partly in South Dakota. A brief discussion of it occurs in the seventh annual report, page 167, and a fuller discussion after investigation in the eighth annual report, pages 157 and 158. No recent work has been done.

WASHBURN PROJECT.

This project is one of the Missouri River pumping projects and is first referred to in the third annual report. It is more fully described in the seventh annual report, page 159. No recent work has been done on the project.

OKLAHOMA.

CIMARRON PROJECT.

This project is referred to in the first annual report under the subject of Cimarron River, pages 271 and 272; in the second annual report, page 426; in the sixth annual report, pages 185 and 186, and in subsequent annual reports. No recent work has been done on the project.

RED RIVER PROJECT.

This project is referred to in the second annual report, pages 414 to 421, and in subsequent annual reports. In the latter part of 1906 more detailed surveys were made of this project, with estimates of cost. Reference to this is found in the sixth annual report, pages 184 and 185. No further work has been done.

OREGON.

Reference is made to some of the earlier investigations in Oregon in the second annual report, pages 433 to 444. More detailed descriptions are found in the second annual report, pages 463 to 476; third annual report, pages 301 to 308, and in subsequent annual reports.

OREGON COOPERATIVE WORK.

The State of Oregon has always been prominent in its readiness to cooperate with the United States in developing its natural resources, and particularly with the Reclamation Service in developing irrigation projects. As early as February 16, 1905, an irrigation act was passed providing, among other things, for cooperation with the United States in hydrographic and topographic surveys and in the construction of works for the development and use of the water supply of the State. This act, copy of which may be found in the fourth annual report, pages 306 and 308, established the office of State engineer in part to provide a central office of record for State water rights. During the following year the State engineer's office cooperated with the Reclamation Service in making a hydrographic survey of Umatilla River to aid in a determination of its water rights. In the latter part of 1912 it was proposed by John H. Lewis, State engineer of Oregon, that an appropriation be asked of the State legislature to cooperate with the Reclamation Service in making some detailed surveys of the irrigation projects in the State not being already constructed, many of which had been considered at various times by the Reclamation Service. E. G. Hopson, supervising engineer at Portland, assisted in promoting the plan. Mr. J. N. Teal, of Portland, Oreg., aided in presenting the matter to the Secretary of the Interior, and his approval, to the extent of allotting $50,000 from the reclamation fund conditional on the State appropriating a like amount, was obtained. In February, 1913, the State legislature passed an act providing for cooperation and appropriating $50,000 conditional on a like amount being allotted from the reclamation fund. Under date of February 27, 1913, an agreement was entered into between the United States and the State of Oregon providing for the manner of conducting the work. In order to conform to Federal laws, a new agreement, under date of May 5, 1913, amending the earlier agreement was entered into. This contract was signed by Franklin K. Lane, Secretary of the Interior, on behalf of the United States, and by John H. Lewis, State engineer, on behalf of the State of Oregon, approved by Oswald West, governor of Oregon; surveys and investigations have been carried out under this agreement.

The investigations and reports were made under the immediate direction of John T. Whistler, engineer, reporting for the earlier investigations to Mr. Hopson. In the investigations and preparation of the reports Mr. Whistler was assisted by F. C. Dillard, W. R. Parkhill, James McKittrick, G. Stubblefield, Thomas Hawthorne, C. M. Whelan, C. E. A. Bennett, D. S. Hays, and Joseph Weare, and by James Dopson, drill foreman. Prof. W. L. Powers, of the Oregon Agricultural College, either personally made or directed most of the soil surveys.

Under this cooperative work there have been investigated 12 different projects, reports for which have been published and distributed. Since published reports are available for the various projects investigated under Oregon Cooperative Work, a very brief description only is given here. Following are descriptions of the projects, with extracts from the reports.

DESCHUTES PROJECT.

This project is on the upper Deschutes River. Storage for 400,000 acre-feet is provided at Benham Falls Reservoir, with dam on Deschutes River about 10 miles above Bend, and for 100,000 acre-feet at Crane Prairie, some 30 miles farther up on the West Fork or main branch.

The normal summer minimum flow of the river at Bend is 1,600 second-feet; the mean annual run-off at Benham Falls for a period of 10 years is approximately 1,200,000 acre-feet.

The area below Benham Falls now irrigated or for which contracts have been made with the State under the Carey Act is approximately 115,000 acres. Carey Act contracts have been made and construction begun for the irrigation of 30,000 acres above Benham Falls on the East Fork.

Additional irrigable areas proposed by this project are: A west side unit of 15,000 acres or more, a north unit of 100,000 acres, and a south unit of 48,000 acres.

The estimated costs per acre of the several units are, respectively, $40.91, $55.58, and $60.44.

It is concluded that the west side and north units are practicable at this time if money can be provided at from 3 to 6 per cent, but that the south unit is not practicable at present.

It was found feasible to develop 20,000 horsepower continuous throughout the year with a load factor of 50 per cent, and with a maximum of 100,000 horsepower limited to the period of the irrigating season.

HARNEY PROJECT.

This project was investigated by the Reclamation Service in 1903. Topographic survey of Silvies Reservoir site and of the irrigable lands of Harney Valley and preliminary plans and estimates were made. In June, 1904, a board of consulting engineers considered the project and recommended that no further work be done because of the complication of water rights. (See second annual report, pp. 435, 436, and third annual report, pp. 469, 470.)

The project, which is located in central Oregon and is within the Great Basin, proposes the regulation of water supply for approximately 60,000 acres of lands now wholly or partly irrigated, and the irrigation of approximately 40,000 acres additional by storage of Silvies River water in Silvies Valley and in what is known as Lower Silvies Reservoir site.

The capacity proposed for Silvies Valley Reservoir is 100,000 acre-feet and for Lower Silvies Reservoir, which will receive the run-off from Emigrant Creek, 70,000 acre-feet. The estimated cost of the former is $350,000 and of the latter $600,000.

The estimated cost of providing storage, distributing system, and drainage for the 40,000 acres of new land under the project is $30 per acre, without interest charges. This includes $7.50 per acre for drainage, part of which may be postponed for some time.

The estimated cost of storage, drainage, and improvement of distributing system for the 60,000 acres of land now wholly or partly irrigated is about $15 per acre of gross area.

There is considered with the project the development of the Blitzen River supply, which in addition to providing for from 60,000 to 70,000 acres as now planned and under construction by the Blitzen Valley Land Co., can be made to reclaim an area of probably 15,000 acres of land about Malheur Lake by storage and pumping from the lake.

There are no practicable power development possibilities in connection with the project other than for small amounts during the irrigating season.

JOHN DAY PROJECT.

The lands considered in the irrigation development proposed by this project lie along the south side of Columbia River between the John Day River on the west and the Umatilla River on the east.

The irrigable area proposed by the project is 122,000 acres. Storage of 112,000 acre-feet is provided on the upper John Day River at Dayville, and of 133,000 acre-feet at what is known as Carty Reservoir site, about 25 miles east of John Day River in the upper edge of the irrigable area. Dayville Reservoir dam site is in a very narrow gorge, but 60 feet wide at the bottom and but little over 200 feet wide at the spillway crest, 115 feet above low water. Carty

Reservoir will be formed by two comparatively low but long earthen dams.

The estimated cost per acre of the project, exclusive of interest, is $125. The most interesting feature of the project, and the most expensive, is the feed canal from the point of diversion in John Day Canyon to the point where it leaves the canyon and turns east to the irrigable lands. The cost of this feature is estimated to be nearly 40 per cent of that of the entire project.

It is estimated that nearly $8,000,000 will have to be expended before the first unit of 11,500 acres can be irrigated.

Investigations were made for several alternative features, including one for transmission of power from Benham Falls, Deschutes project, and pumping to the project from Columbia River. The estimates show all these to cost somewhat more than the estimated cost for the project proper. There are no practicable power possibilities in connection with the project.

MALHEUR PROJECT.

Extensive investigations were made of this project by the Reclamation Service in 1903 and 1904 in connection with the Owyhee project. (See third annual report, pp. 102, 103; fourth annual report, pp. 301–304; and fifth annual report, pp. 253, 254.) In 1909 a further investigation and study of the project was made by the service. This is referred to in the eighth annual report, pages 160 and 161. In these earlier investigations by the service extensive diamond drill borings were made on Owyhee River and on Malheur River below the junction of the North Fork. Topographic surveys were made of all reservoir sites and of the irrigable areas. Little field investigations therefore remained to be done for further consideration of the project.

At the time of the early investigations there was no railroad up Malheur Valley, and largely for this reason storage investigations on Malheur River were confined to the main river. Stream measurement data obtained since that time show that probably 55 per cent of the run-off of Malheur River is from what is generally referred to as the Middle Fork. On this fork, about 3 miles above the mouth of the South Fork, there exists an excellent dam site for what is referred to as Warm Springs Reservoir site. Diamond drill borings at this site made under the present investigations developed good foundation for a masonry dam at from 7 to 11 feet below the surface of the river.

Since the earlier investigations considerable areas along Snake River have been supplied with water by electric pumping from that stream. A revision of the project, therefore, to adapt it to the new conditions, was advisable.

The general plan of the project now proposed is storage of water at Warm Springs Reservoir site and the irrigation of approximately 40,000 acres of land in Malheur Valley only.

The estimated cost of the reservoir with 159,000 acre-feet capacity, raising the water 84.5 feet, is approximately $390,000, or $2.45 per acre-foot capacity. The estimated cost per acre-foot of mean yearly storage supply required, measured at the several river diver-ons of the valley, is a little less than $4.

Plans and estimates provide for extensive drainage, the estimated cost of which is approximately $335,000; the average cost to approximately half the project is about $17 per acre. The total estimated cost of the entire project, including drainage, is $1,438,000, an average cost of approximately $37 per acre.

No electric power development is practicable in connection with this project.

OCHOCO PROJECT.

This project proposes the irrigation of some 15,000 acres of land north of Crooked River, a tributary of the Deschutes River, in the vicinity of Prineville. In the reconnoissance investigations of projects in central Oregon, referred to in the eighth annual report, page 160, it was proposed to serve the lands of this project, or part of them, by storage at what is known as the Post Reservoir site on upper Crooked River at the mouth of North Fork. It was proposed as the principal feature of this Crooked River storage to supply what has been referred to as the north unit of the Deschutes project. The investigation of possible development from Crooked River was therefore made as an essential part of the Ochoco project investigations and is included in the published report with the Ochoco project.

It was found more economical to serve the lands of the north unit of Deschutes project by Deschutes River water and the Ochoco project from Ochoco Creek, with storage about 6 miles above Prineville.

The Ochoco Reservoir will have a storage capacity of 40,000 acre-feet, with crest of spillway 113 feet above low water.

The estimated cost of the project, without interest, is $51.30 per acre. The estimated cost of serving the same lands from Crooked River, in connection with lands of the north unit of Deschutes project, is $83 per acre.

The mean run-off of Crooked River at Post Reservoir site is approximately 215,000 acre-feet. A dam raising the water 131 feet would provide a storage capacity of 260,000 acre-feet, at an estimated cost of $877,000, or a little less than $3.40 per acre-foot of capacity.

This comparatively cheap storage suggested the possibility of its use to supplement low-water periods of lower Deschutes River for various power-development projects on lower Deschutes River, as they would be affected by the construction of the Deschutes irrigation project proposed.

Investigations of Deschutes River power possibilities have been made by the United States Geological Survey, the results of which appear in Water-Supply Paper 344. A study of the economic applicability of Crooked River storage to such power developments shows that it will not be economical until a total head of approximately 200 feet has been developed on lower Deschutes River, with the assumption of a possible modified flow of approximately 4,000 second-feet minimum below the mouth of White River.

It is concluded in the report that the cost of the project can probably be borne by the land if interest charges on capital necessary for construction do not exceed 3 to 4 per cent.

OWYHEE PROJECT.

Investigations for this project were made in connection with the Malheur project. It is referred to at some length in the fourth annual report, pages 303 and 304, and in subsequent reports with the Malheur project.

Extensive surveys and dam-site investigations for this project were made in 1904 and 1905. Since these investigations much of the irrigable area considered at that time has been served by electric power pumping from Snake River. A revision of the plans and resulting estimates of cost was therefore desirable. Very extensive surveys and investigations of dam sites were made in these earlier investigations, and comparatively little field work has therefore been necessary in the present investigations.

The Owyhee River, which has a greater run-off than the Malheur River, has been considered at various times as a source of supply for the greater part of the lands of the Malheur project. The rugged canyon of the Owyhee River, which extends nearly to its mouth, makes impracticable the high diversion necessary to cover more than a comparatively small area near the Owyhee River.

The development now proposed is the irrigation of about 18,000 acres of land lying on both sides of Owyhee River in the vicinity of Mitchell Butte and, in addition, the inclusion of possibly 5,000 acres now served by one of the higher lift pumping projects from Snake River.

Storage for the project is to be provided at Duncan Ferry Reservoir site, on Owyhee River, by a dam just below the mouth of Jordan Creek. A diversion dam to raise the water about 66 feet is required. In order to reach some of the higher lands and avoid the high and expensive diversion which would be required to serve them by gravity, a drop is proposed from the main canal at Mitchell Butte to lower lands and this drop used to serve the higher lands by direct-connected turbine and pump. Water will be carried to the south side of Owyhee River from main canal by inverted siphon.

Duncan Ferry Reservoir will have a capacity of 100,000 acre-feet with spillway crest of dam 72 feet above low water. Estimates include capitalization of maintenance and operation of pumping plants and inverted siphon. The estimated costs per acre vary from $50.50 to $68.13.

Construction of the Owyhee diversion dam will provide a head of about 66 feet which it will be possible to utilize for the development of electrical power. Additional storage capacity at Duncan Ferry reservoir site would be comparatively cheap. The normal period of high water in Owyhee River is, however, very short, and the storage necessary to furnish a supply for power during the long low-water period, extended as it will be with development of the irrigation project, makes the estimated cost of electric power development $120 or more per horsepower for the cheapest development, probably about 1,000 horsepower.

Report on this project has been published in connection with that for the Malheur project as "Malheur and Owyhee projects."

ROGUE RIVER VALLEY PROJECT.

In the earlier investigations in Oregon by the Reclamation Service no consideration had been given to possible projects west of the Cascade Mountains. That part of this area west of the Coast Range, and also a considerable part of the west side of the Cascade Range itself, has a very high annual precipitation, reaching in places 100 inches or more. The normal annual precipitation of the valleys between the mountains ranges from a little over 40 inches in the vicinity of Portland to less than 20 inches in Rogue River Valley, and during the growing season, even in Willamette Valley, the precipitation is less than 3 inches per annum. Irrigation is therefore almost as essential to the best agricultural development in this region as in the region east of the mountains.

Rogue River Valley, the name generally applied to that portion of Rogue River Basin about Medford and extending from Ashland in the south to Tolo in the north, has developed a high grade of apple and pear orchards. Occasional years of low precipitation with more than ordinarily dry summers had brought about the irrigation of a few orchards by pumping 10 years or more ago. The results from these small developments showed the value of an irrigation supply, and about that time the development of a project by private capital, the Rogue River Valley Canal Co., to supply a part of the valley by storage in Fish Lake, was taken up. As in the case of so many projects of this character, however meritorious in the conception, acceptance by the landowners has been slow.

In addition to the project already referred to a number of alternative or additional water supplies have been proposed from time to time, and in order that the entire situation might be considered and discussed by unprejudiced engineers, the State engineer was requested by the water users' association, with the approval of the Rogue River Valley Canal Co., to include investigation of water supplies for Rogue River Valley as one of the Oregon cooperative work projects.

After obtaining assignment of certain undeveloped water-right claims the investigations were taken up. The project can not be fully described here, but published reports of the project are available. In brief, the project includes development of the water supply approximately as proposed by the Rogue River Valley Canal Co. for that part of the valley referred to as the Medford division, and the development of supply for the Ashland division by storage in one or more of Buck Lake, Hyatt Prairie, and Beaver Creek reservoir sites, with an alternative of development of supply from streams on the north and west sides of Ashland Butte. The estimated costs of the various supplies and alternatives considered vary from $40 per acre to $75 per acre, exclusive of interest charges.

There are now two hydroelectric power plants on Rogue River in this vicinity. No further power development appeared practicable nor seemed desirable in connection with irrigation possibilities investigated.

The maximum storages considered at the various reservoir sites are:

Fish Lake, 20,000 acre-feet, with 50-foot dam.

Four Mile Lake, 15,500 acre-feet, with 20-foot dam.
Buck Lake, 30,000 acre-feet, with 23-foot dam.
Beaver Creek, 46,000 acre-feet, with 75-foot dam.
Hyatt Prairie, 20,000 acre-feet, with 47-foot dam.

SILVER CREEK PROJECT.

Investigations of this project were made by the Reclamation Service in 1903 and 1904. (See third annual report, pp. 471, 472.) The project is within the Great Basin. Silver Creek is a tributary of Harney Lake, which in turn receives the overflow from Malheur Lake of Harney Valley. Harney Lake has no outlet. There is a considerable area of attractive irrigable land under the project. The reservoir site considered is also comparatively economical. No records of discharge of Silver Creek were available prior to the investigation. Subsequent records have shown the discharge to be very erratic and that there are seasons when the total run-off is diverted to the lands now cultivated. For this reason no further consideration was given the project until recently. Railroad construction into the valley now makes it possible to consider construction for holdover storage. The surveys and earlier investigations have therefore been reviewed, and revised estimates and report prepared. The report is published in connection with that for Harney project as "Harney and Silver Creek projects."

In the report now made there has been included consideration of development and use of water supply from Warm Springs, in the lower end of Silver Creek Valley, from which there is available an unappropriated supply of probably 15,000 acre-feet, which may be used for new development through pumping and storage. The use of Silver Lake for storage of this water and also its possible use in connection with storage from Silver Creek itself have also been considered in this report. Silver Creek Reservoir as proposed will have a capacity of 40,000 acre-feet with a dam raising the water 72 feet. The estimated cost of this storage is $400,000.

It is proposed to irrigate about 12,000 acres of the best land in Silver Creek Valley not now irrigated, in addition to providing storage for a higher development of the lands assumed to have more or less of a water right, not to exceed 12,000 acres. Five dollars per acre is provided in the estimate for drainage of lands now irrigated. It is assumed this will provide for the most urgent needs in connection with the proposed higher development of these lands with a stored supply. The estimated cost for storage and distribution to new lands is $30 per acre, and to lands having prior water rights $20 per acre, including $5 per acre for drainage.

No power development is practicable in connection with this project, though cheap power, if it could be obtained, would very much simplify the development proposed for the lower valley, where low-lift pumping from Warm Springs to Silver Lake is proposed.

It is concluded in the report that the project is feasible provided a reasonable agreement can be entered into with prior water-right claimants covering supplies for new lands, that the lands of the proposed project not now irrigated be largely developed by dry farming prior to the completion of the project, and that money for construction be secured at a low rate of interest, not greater than 6 per cent, with no payment of principal of construction cost during the first few years after construction and with at least 20 years in which to complete payments.

SILVER LAKE PROJECT.

Investigations for this project were first made by the Reclamation Service in 1904. (See third annual report, pp. 474, 475, and fourth annual report, p. 306.) Further reconnoissance examination of this project was made in 1908. (See eighth annual report, p. 160.)

Silver Lake and its drainage area are within the Great Basin. The town of Silverlake is on Silver Creek, the main tributary of Silver Lake, about 6 miles east of the lake. The general elevation of the region above sea level is 4,500 feet. The mean precipitation at Silverlake over a period of 27 years is a little less than 11 inches. Although the growing season is short, this is insufficient for crops except where water is near the surface, especially as comparatively little of the precipitation occurs during the growing season.

Silver Lake has no outlet except in years of unusually high run-off, when the excess water discharges north into Thorne Lake and Christmas Lake Valley, low portions of what was once a prehistoric lake of probably the same geologic age as Lakes Bonneville and Lahontan. The water of Silver Lake itself is entirely fresh, and it is this fact, together with the area of low lands to the north, that induced the original investigations for this project.

As the investigations have continued from time to time and a better knowledge has been obtained of the run-off of Silver Creek and tributaries, other irrigable areas and other storage sites have appeared more desirable. There had also been considered in the earlier investigations the possibility of diverting water from Sycan Marsh of Klamath drainage basin across a low divide into the Silver Lake Basin. (See fourth annual report, p. 306.)

This was therefore taken up in the recent cooperative work investigation, and careful surveys made of Sycan diversion possibilities and storage sites.

The project now proposed is the diversion of a maximum of between 500 and 600 second-feet from Sycan Marsh streams during the nonirrigating season across the low divide to Thompson Valley Reservoir on upper Silver Creek, the storage of this water together with upper Silver Creek run-off during nonirrigating period, and the use of these waters to regulate and complete the supply for about 8,000 acres now irrigated, to supply about 16,000 acres of new lands in the vicinity of the town of Silverlake and 32,000 acres in the vicinity of Fort Rock; and the possible development of summer power on Silver Creek for use in pumping to reclaim part of Silver Lake bed, for pumping from ground water to supply additional lands in Fort Rock Valley, and for pumping from Ana River Springs for the irrigation of possibly 20,000 acres of land in Summer Lake Valley. This latter feature has been considered in earlier investigations in connection with Chewaucan project, now being developed by private capital under the Carey Act. (See third annual report, pp. 473, 474, and subsequent reports.)

Two embankments will be required for Thompson Valley Reservoir; the main one will be about 56 feet high, raising the water approximately 49 feet to spillway crest; the smaller embankment will be about 36 feet high, with top 7 feet above spillway crest. The storage capacity provided by Thompson Valley Reservoir is 66,500 acre-feet. The estimated cost of this storage, including lands, is $177,725, or $2.67 per acre-foot of capacity. The net mean amount of storage supply available is estimated to be a little over 48,000 acre-feet; the cost, therefore, of net storage supply available is $3.70 per acre-foot.

The average estimated cost per acre of new lands under the project is $28.45, exclusive of the estimated 8,000 acres having incomplete water rights, the storage and regulation of natural flow for which are estimated to cost $2 per acre.

Other alternatives are discussed at length in the published report.

The possibility of supplying the lands of Fort Rock and Christmas Lake Valleys from Odell and Crescent Lakes in the headwaters of Deschutes River was considered by the Reclamation Service in the earlier investigations. (See Odell and Crescent Lakes project, third annual report, pp. 475, 476.) This project is now considered impracticable, and moreover the waters of Deschutes River Basin can be used to better advantage on features of Deschutes project.

WARNER VALLEY PROJECT.

The remoteness of Warner Valley from railroad transportation made it appear undesirable to expend money in investigations in this region during the earlier investigations of the Reclamation Service. The only reference to it is in the second annual report, page 438. Since that time the railroad has been constructed to Lakeview, in Goose Lake Valley, about 30 miles across the intervening mountain ridge from Warner Valley, and surveys for railway location through Warner Valley and Surprise Valley, Cal., have been made. Warner Valley is within the Great Basin, near the State line, in south-central Oregon. A chain of lakes occupies the bottom of the valley. By far the larger part of the run-off into the valley is in the southern end, and the water surface of the lakes at this end is ordinarily some 10 feet higher than that of the lowest lake at the north end. With the exception of this latter lake, and perhaps the adjoining lakes, the waters of these lakes are fresh.

Various plans have been considered by the Warner Lake Irrigation Co., a Carey Act company, for reclaiming the lands of the valley. A large amount of money has been spent in surveys, but up to the summer of 1915 they had been unsuccessful in promoting the project, and it was proposed by the company to turn over the available data to the Reclamation Service for use in further investigations and report. Withdrawals of public land and water have been made for the protection of the investment by the United States and the State, and further investigations have been made, a report on which has been published.

Two lines of development are naturally suggested—one, the reclamation of lands in the north end of the valley by development of power on Deep Creek, the main stream entering the valley, and pumping to higher lands of the northern portion of the valley; the other, the reclamation of the swamp lands of south Warner Valley by drainage and pumping by the same power, with incidental pumping for irrigation.

In the recent investigations a soil survey of the valley indicated in general that lands of north Warner Valley reclaimed would not be so valuable as south Warner. The project as now proposed is, therefore, the drainage of approximately 46,000 acres of swamp land in the valley, the irrigation of 33,000 acres of these lands in south Warner Valley by gravity canals, and pumping to irrigate 27,000 acres in north Warner Valley.

Deep Creek has excellent power development sites in its lower courses, and an exceptionally economical reservoir site at Big Valley, some 15 miles above its mouth. It is proposed to develop about 2,000 electrical horsepower on this stream for operating dredges during construction and to furnish permanent power to four pumping plants in north Warner Valley on completion of the project.

There are evidences of extreme run-off into the valley which annually inundates a portion of south Warner Valley proposed in the present project to be reclaimed. It is planned to take care of such excess run-off by the storage at Big Valley on Deep Creek referred to, and in Coleman Valley, which is virtually a south extension of Warner Valley, receiving little or no run-off and being lower than the lands of south Warner proposed to be reclaimed by drainage. The storage capacity of Coleman Valley without embankment and without pumping is approximately 60,000 acre-feet. The mean annual discharge available at Big Valley reservoir site is probably 50,000 acre-feet. Following is a tabulation of capacities of this reservoir site:

Depth (feet).	Area (acres).	Capacity (acre-feet).	Depth (feet).	Area (acres).	Capacity (acre-feet).
10	80	400	35	3,360	58,100
15	1,220	3,400	40	3,520	75,300
20	2,440	13,000	45	3,750	93,500
25	2,900	26,500	50	3,840	112,400
30	3,200	41,700			

Storage capacity for 100,000 acre-feet is provided in the plans and estimates at this site.

The estimated cost of this development is $1,726,000, or a little less than $29 per acre. The elevation of the project above sea level is approximately 4,500 feet. Notwithstanding this high altitude, however, portions of the valley now grow fruit successfully, with only occasional failure. It is concluded in the report that the mean water supply for irrigation in the valley is something less than 200,000 acre-feet, that the minimum run-off may be less than half this amount, and that the extreme maximum may be possibly two or three times this amount; and it is recommended that the project be regarded as a feasible project whenever the owners of the lands under it indicate a desire to have development undertaken and when railway transportation into the valley can be assured.

WHITE RIVER PROJECT.

White River, a tributary of lower Deschutes River, has its source in one of the glaciers of Mount Hood. It derives its name from the fine particles of whitish sediment carried (probably lava ash) from the glacier or somewhere in its course.

No early investigations of this project have been made by the Reclamation Service, and the present investigations consist of a personal reconnoissance only by C. E. A. Bennett. The report is based on this reconnoissance, together with whatever other information could be obtained, including Deschutes River power survey by the United States Geological Survey. (See Water-Supply Paper 344.) White River drainage basin has an area of about 350 square miles, generally forested in the upper regions. Run-off records are available for but four years. They show a mean annual run-off of about 234,000 acre-feet. The annual precipitation over the irrigable area is about 14 inches, with about 3½ inches during the irrigating period.

The project proposes diversion from White River to lands near its mouth, supplemented by storage in Clear Lake, with additional diversions on the north side from three minor tributaries. The gross irrigable area under the project is approximately 80,000 acres, with net irrigable area estimated at 40,000 acres. Storage capacity of 18,000 acre-feet is proposed at Clear Lake.

There is a hydroelectric power plant on White River below the proposed diversion which will have to be taken over for the full development of the irrigation project. The estimated cost of irrigating 36,000 acres is $36 per acre, including purchase of this power plant.

A small amount of work has been done on a project diverting from White River by the Wapinitia Irrigation Co. In the development of a project it will be necessary to consider the water-right claims by this company.

The conclusions reached in the report are that the project as outlined will become attractive only with the growth of a demand for irrigation sufficient to make economically desirable the absorption of all other claims to the available water supply.

Report on this project is published in connection with that of Warner Valley project.

WILLAMETTE VALLEY INVESTIGATIONS.

Until comparatively recently irrigation in the Willamette Valley has not been considered by the landowners. Within the last few years, however, many individual farmers have irrigated by means of pumping or diversion from small streams, and the value of irrigation even in Willamette Valley has thereby become known.

No investigations had heretofore been made by the Reclamation Service in Willamette Valley, but in connection with the cooperative work it appeared desirable to develop if possible the outline of a project for future consideration. To this end Mr. D. S. Hays spent a large part of the season of 1915 making reconnoissance for possible projects.

Power development at Willamette Falls, Oregon City, has increased until at this time all of the minimum flow of Willamette River is utilized. Any extensive irrigation development in the valley above will therefore require either adjustment with the power companies at Oregon City or storage to supply that part of the water required for irrigation during the period of low discharge at Willamette Falls. The reconnoissance therefore included investigations of storage possibilities on all of the principal streams tributary to Willamette River.

The investigations included, also, the possibility of ground water supply for pumping, and the report includes tabulations of data relating to pumping from wells. Reference is made in the report to power development possibilities on the North Fork of Santiam River with storage at Marion Lake, on the upper reaches of McKenzie River, including the two existing and proposed power plants, and on Middle Fork of Willamette River with storage at Waldo Lake.

Some construction work was done at Waldo Lake by the Waldo Lake Irrigation & Power Co. some years ago, but they appear to have been unable to further finance the enterprise.

It is estimated in the report that a run-off of probably 135,000 acre-feet can be made available for storage in this lake, and that this supply alone, if used for irrigation and transmitted to the lands under assumptions made as to loss and necessary duty, would be sufficient to irrigate more than 100,000 acres in Willamette Valley.

Drainage is found to be of probably more importance to most of the valley than irrigation, and must precede it.

It is concluded in the report that lands of the valley, with drainage and irrigation, can be made in general probably to double their yield in years of ordinary precipitation; that the cost of diversion canal construction, without storage, for the areas proposed, will be less than the increased value of the land resulting therefrom; and that storage can be developed at Waldo Lake alone at a cost of probably less than $5 per acre, sufficient to permit the irrigation of all the areas proposed in the report, without interference with the power supply at Oregon City.

It is also concluded in the report that it is inadvisable to undertake to promote comprehensive irrigation projects in Willamette Valley at this time, or until small projects have made clear to everybody the value of drainage and irrigation.

A report on Willamette Valley investigations is published in connection with that of Rogue River Valley project.

COLUMBIA RIVER COOPERATION, COLUMBIA RIVER POWER PROJECT.

This project proposes the development of hydroelectric power at Celilo Falls on Columbia River. Because of the interest which the Reclamation Service might have in it through use of cheap power for pumping for irrigation, funds for the investigation equal in amount to the appropriation by the State were allotted from the reclamation fund.

Attention was directed to the possibilities of developing large water powers on Columbia River near The Dalles, Oreg., by a supplement to the fourth biennial report of John H. Lewis, State engineer of Oregon, entitled "The Columbia Power Project," being Bulletin No. 3, dated January 11, 1913.

This report, addressed to Hon. Oswald West, governor of Oregon, recommended that money be appropriated by the legislature for a thorough investigation of one or more specific projects, to the end that a comprehensive water power policy might be framed.

The State legislature, by act of March 4, 1913 (ch. 374, General Laws of Oregon, 1913), appropriated the sum of $15,000 for this purpose. The fund was placed in the hands of an investigating committee, consisting of I. N. Day and J. C. Smith, of the State senate; J. D. Abbott and Vernon A. Forbes, of the house; and John H. Lewis, State engineer.

By provision of this act the committee was given authority to enter into a contract with the State of Washington or the Federal Government, or both, for the general conduct of the investigation. Subsequently, on invitation of the committee, the Secretary of the Interior allotted from the reclamation fund an equal amount, $15,000, for the investigation, under a cooperative agreement which was executed under date of December 12, 1913, by E. G. Hopson, supervising engineer, on the part of the United States, and I. N. Day, J. D. Abbott, and John H. Lewis on the part of the State. The committee was unable to obtain cooperation by the State of Washington.

Under the terms of the agreement E. G. Hopson, supervising engineer, was assigned by the Secretary of the Interior to supervise operations. On February 2, 1914, Mr. L. F. Harza, of Portland, Oreg., was appointed project engineer for the investigation. Field and office work were under Mr. Harza's immediate direction. All studies and conclusions, except as specified in the report itself, were compiled and written by Mr. Harza in conference with E. G. Hopson, supervising engineer, and O. H. Ensign, consulting electrical engineer.

Briefly, the power project proposed is to control the river by means of a comparatively low controlling weir and develop power by successive units discharging from a broad forebay on the Washington side of the river. The flow of the river varies from about 50,000 second-feet to over 1,000,000 second-feet. The operating head will vary from a minimum of about 45 feet under flood conditions to 105 feet at low water. The power which can be developed continuously 24 hours per day throughout the year aggregates nearly 500,000 electrical horsepower, with the practicability of developing large amounts of additional power for parts of the year.

On recommendation of Mr. Hopson, a board of review for the report on this project was appointed by the Secretary of the Interior. This board met at The Dalles, Oreg., November 19, 1914, and subsequently at the Portland office of the Reclamation Service. The board of review consisted of Gen. W. L. Marshall, consulting engineer to the Secretary of the Interior; D. C. Henny, acting chief engineer of the Reclamation Service; Ralph Mojeski, consulting engineer; and W. F. Durand, professor of mechanical engineering, Stanford University. Following are extracts from the report of this board.

The principal technical problems center around the following features:

(*a*) The closure of the present channel;
(*b*) The provisions of suitable control gates for flood conditions;
(*c*) The main power canal; and
(*d*) The power house and generating machinery.

Features (*c*) and (*d*) present no problems of unusual difficulty. With regard to features (*a*) and (*b*), however, the problems are found to be somewhat beyond direct precedent, both in magnitude and character. It is the judgment of the board that the engineering feasibility of the project as a whole will be determined by the question of these two features, which are viewed as the controlling engineering problems. The board is of the opinion, however, that the present resources of engineering art offer every reasonable assurance of a possible and practicable solution. The board in the brief time at its disposal was not able to make a detailed review of the estimates of cost, but indorsed as reasonable the general schedule of costs used in the main report. It concluded that the project as outlined in the main report could be completed for a sum which, including interest during construction, might approximate $55,000,000.

Owing to insufficient funds the report was not published under Columbia River Cooperation, but it has since appeared serially in the Journal of Electricity, Power, and Gas, of San Francisco. The entire printed report under single cover can be obtained from the publishers of that periodical.

SOUTH DAKOTA.

BOWMAN PROJECT.

This project lies partly in North Dakota and partly in South Dakota. (See North Dakota, p. 526.) No recent work has been done on this project.

UTAH.

BEAR LAKE PROJECT.

This project was discussed in the first annual report, pages 282 to 287; in the second annual report, pages 475 to 486, the project is described and discussed at considerable length by G. L. Swendsen, and in the third annual report, pages 514 to 544, by W. P. Hardesty. Further reference to it is made in subsequent annual reports. No recent work has been done on this project.

UTAH LAKE PROJECT.

This project was referred to in the first annual report, pages 279 to 282, under "Utah Lake Regulation." It was discussed at greater length by G. L. Swendsen in the second annual report, pages 451 to 475, and in the third annual report, pages 494 to 514. Reference is also made to it in subsequent annual reports. No recent work has been done on the project.

WASHINGTON.

PALOUSE PROJECT.

This project was first referred to in the third annual report, pages 112 and 600 to 606. In the fourth annual report, page 345, results of investigations, with estimates of cost and unfavorable recommendations by board of consulting engineers, are given. In the fifth annual report, page 292, reference is made to investigation and further recommendation against immediate construction, by C. E. Grunsky.

No further consideration was given to this project until 1913, when an appropriation was made by the State for further investigation of the project, and a cooperative agreement for this investigation was entered into between the State and the Reclamation Service. This work has been conducted as Palouse cooperative work.

At the solicitation of citizens of Whitman and Franklin Counties, Wash., within which the larger part of the project, including the reservoirs, lies, the Legislature of the State of Washington at the 1912–13 session, passed a bill authorizing further investigation of the feasibility of this project and appropriated $10,000 for the purpose. On solicitation of the governor, cooperation with the Reclamation Service was proposed, and under date of November 18, 1913, a contract was entered into with the Secretary of the Interior whereby a like amount of $10,000 was allotted from the reclamation fund for the investigations.

Under this agreement E. McCulloh was assigned as engineer in charge of the investigations, and active operation was begun in December, 1913. Investigations and surveys of the larger part of the field had been made by the service in 1902 to 1905. These data were made available and saved the larger part of what would otherwise have been necessary to the cooperative investigations.

The cooperative investigations, besides reconnaissance for alternative storage sites, included detailed surveys of Wiedrich, Hinchliff, State Line, and Potlatch reservoir sites, the last two sites being across the boundary in the State of Idaho. Examinations were also made to determine if suitable bodies of land within the Palouse River basin could be reached by gravity canals below points of storage, and thus save the high expense of the canal from Palouse River basin to the irrigable area heretofore considered. No such area was found.

Capacities of the new reservoir sites investigated are as follows:

	Acre-feet.
Wiedrich site, raising the water 110 feet	157,000
Hinchliff site, raising the water 82 feet	22,000
State Line site, raising the water 35 feet	16,500
Potlatch site, raising the water 65 feet	120,000

Report on the cooperative investigations was made by Mr. McCulloh in August, 1914. This report was reviewed by a board of engineers consisting of D. C. Henny, Charles H. Swigart, and A. J. Wiley for the Reclamation Service, and Marvin Chase and J. C. Ralston for the State of Washington. Their report was made October 1, 1914.

With some minor changes in unit prices and some material changes as to estimated cost of land purchases for reservoir sites, the board's report generally approved that by Mr. McCulloh. Of the new reservoir sites investigated, the estimated cost by the board for the cheapest, the Potlatch, was $14.50 per acre-foot for 90,000 acre-feet capacity. The cost per acre of land irrigated as estimated by the board was $100 for 53,500 acres, with Washtucna Reservoir alternative. The feasibility of this reservoir site was questioned by the board, and the alternative with Potlatch Reservoir for the same irrigable area was $123 per acre. This high cost per acre was regarded by the board as prohibitive at this time.

The project involves pumping for approximately 13,000 acres. The board found that power development for irrigation pumping would be advisable if the project were feasible, but that power development for commercial uses in connection with the project would not be practicable.

PRIEST RAPIDS PROJECT.

This project was first investigated for the Northern Pacific Railway in 1896. Briefly, it proposes the irrigation of about 150,000 acres in the vicinity of Priest Rapids on the Columbia River, mostly by pumping with hydroelectric power developed at the rapids. (See third annual report, pp. 609–611; fourth annual report, pp. 342–345; and subsequent reports.) No recent work has been done on this project.

WYOMING.

LAKE DESMET PROJECT.

This project is referred to in the first annual report, pages 307 and 308. It is discussed at greater length in the second annual report, pages 517 to 528. Reference is also made to it in subsequent reports. No recent work has been done on the project.

WYOMING COOPERATIVE WORK.

In the investigations in Colorado River Basin (see p. 514) of water requirements and storage possibilities there is involved the question not only of water uses which have become vested but of possible future uses of water in the various States and their relation to each other, as well as the rights of Mexico to present and possible future uses of water by reason of the Colorado River being an international stream. It was suggested by Mr. Richardson, who had charge of the Colorado River Basin investigations in 1914 and 1915, that investigations as to irrigable areas within the Colorado River Basin in Wyoming be made a cooperative investigation with the State of Wyoming. Accordingly a letter by the director and chief engineer of the Reclamation Service was addressed to the governor of Wyoming, under date of April 8, 1915, briefly outlining the scope and purpose of the Colorado River Basin investigations and proposing that the State of Wyoming cooperate with the Reclamation Service in that part of the work coming within the State of Wyoming. The proposal met the approval of the governor, Hon. John B. Kendrick, and on June 1, 1915, a cooperative agreement was entered into with the State of Wyoming providing for these investigations, as referred to in the fourteenth annual report, page 323. The agreement was signed by W. A. Ryan, for the Reclamation Service, and by James B. True, State engineer, approved by John B. Kendrick, governor, for Wyoming. It provided for the expenditure of $2,500 each for the purpose of the investigation. The work under the terms of the agreement was carried on under direction of John F. Richardson, engineer, United States Reclamation Service, in cooperation with H. A. True, jr., chief engineer, Cary Act department, Wyoming. In accordance with the agreement, investigations were made and a general report submitted, signed by Mr. Richardson for the Reclamation Service and Mr. H. A. True, jr., for the State of Wyoming. The agreement further provided that on completion of the report with conclusions and recommendations the report should be reviewed by a board of three, consisting of an engineer appointed by the Secretary of the Interior, one appointed by the governor of Wyoming, and a third to be selected by the two so appointed. Inquiry has been directed to the State engineer to know what his wishes and those of the governor are with respect to this board, as there remain of the $5,000 fund provided less than $300 unexpended.

The report is extensive, containing a number of maps and tables which can not be given here. The following statement gives the probable mean run-off, in acre-feet, by months, of streams in Colorado River Basin in Wyoming, based on discharge measurements of Green River at Bridgeport, Utah, extending over six years, incomplete records for five years of little Snake River at Dixon, Wyo., and a few miscellaneous measurements of Muddy Creek, at Baggs, Wyo.:

January	40,000
February	45,000
March	95,000
April	250,000
May	475,000
June	650,000
July	870,000
August	150,000
September	95,000
October	80,000
November	60,000
December	40,000
Total	2,350,000

The estimated area of irrigable lands in Colorado River Basin, Wyo., is as follows:

Class.	Estimated areas irrigated, 1915.			New areas.	Total.
	Tilled.	Untilled.	Total.		
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Bottom lands	24,000	347,000	371,000	99,700	470,700
Bench lands	11,800	....	11,800	1,480,900	1,492,700
Total	35,800	347,000	382,800	1,580,600	1,963,400

Storage-reservoir sites in Colorado River Basin, Wyo., exclusive of Flaming Gorge site, the dam site of which is in Utah, are reported as follows:

Reservoir sites above Green River City, Wyo.

Stream.	Existing reservoirs.		Proposed reservoirs covered by State filings.		Proposed reservoirs partly covered by State filings.	
	No.	Capacity (acre-feet).	No.	Capacity (acre-feet).	No.	Capacity (acre-feet).
Sandy	1	17,300	1	105,000	....	....
La Barge	....	....	1	4,030	....	....
Middle Piney	....	....	1	11,100	....	....
North Piney	1	4,329	2	6,753	....	....
Green River	....	....	....	....	1	100,000
New Fork	....	....	....	....	6	419,900
Total	2	21,629	5	126,883	7	519,900

Reservoir Sites on Hams Fork, Blacks Fork, and Henrys Fork.

Stream.	Existing reservoirs.		Proposed reservoirs covered by State filings.		Proposed reservoirs partly covered by State filings.	
	No.	Capacity (acre-feet).	No.	Capacity (acre-feet).	No.	Capacity (acre-feet).
Hams Fork	....	....	....	....	1	70,000
Blacks Fork	....	....	1	18,000	3	[1] 11,772
Henrys Fork	....	....	....	....	1	[1] 107,000
Total	....	....	1	18,000	5	188,772

[1] In Utah.

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 747.]

Cost of secondary projects for fiscal year 1916 and cost to June 30, 1916.

	Cost for fiscal year 1916.	Cost to June 30, 1916.
Arizona:		
Little Colorado		$9,554.88
San Carlos		24,829.51
San Pedro		2,427.34
Arizona cooperative work, drilling	$83.96	83.96
Arizona-California:		
Colorado River	32,504.63	43,710.00
Colorado River Basin		83,708.31
California:		
Owens Valley		12,061.92
Sacramento Valley		43,620.72
San Joaquin		3,531.20
Iron Canyon cooperative	85.06	9,549.13
Pit River cooperative	30.25	2,499.18
Shasta County cooperative	410.70	2,290.84
Lassen County cooperative	894.32	1,945.60
Colorado: White River		4,357.00
Idaho:		
Dubois		17,228.91
Port Neuf		2,168.01
General investigations		1,191.78
King Hill	623.45	738.39
Montana:		
Clarks Fork		5,581.23
Crow Reservation		18,911.96
Lake Basin		7,103.26
Madison River		10,729.09
Marias	79.59	13,538.60
Nebraska:		
South Platte		2,877.01
Nebraska investigations		3,381.70
Pathfinder pumping	1,507.36	1,507.36
Nevada: Walker River	292.30	13,696.37
New Mexico:		
La Plata		28,064.33
Las Vegas		5,014.09
Urton Lake		17,464.70

North Dakota:		
Bismarck		$13,621.69
Little Missouri		11,933.52
Nesson		17,471.83
Washburn	$1.20	10,532.73
Bowman	[1] 287.90	2,948.74
Oklahoma:		
Cimarron		8,891.17
Red River		60,209.27
Oklahoma reconnaissance		400.00
Oregon:		
Malheur		83,490.62
Central Oregon		40,346.41
Columbia River cooperative	560.00	17,008.51
Oregon cooperative	9,490.27	49,979.10
Texas: Pecos River investigations	693.80	7,115.47
Utah:		
Bear Lake		18,827.72
Utah Lake		34,049.30
Provo Weber		141.35
Washington:		
Benton	[1] 31.20	11,073.85
Kittitas		19,366.90
Wapato		36,465.77
Palouse		76,393.01
Palouse cooperative	.28	10,067.12
Priest Rapids		6,216.01
Wyoming:		
De Smet		8,917.38
Wyoming cooperative	2,345.66	2,345.66
Miscellaneous preliminary investigations		80,488.73
Gross cost to June 30, 1916	49,283.73	1,021,667.69
Less revenues earned during construction period:		
Loss on mess-house operations	[1] 2,442.66	
Profit on hospital operations	394.50	
		[1] 2,048.16
Net cost to June 30, 1916		1,023,715.85

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[1] Deduct.

Estimated cost of contemplated works of secondary projects for fiscal year 1917.

Principal feature: Estimated expenditures during fiscal year 1917, examination and surveys	$50,000

INDIAN IRRIGATION PROJECTS.

The Indian reservations of the United States lie very largely in the arid portion of the country. Long before the passage of the reclamation act and the resultant creation of the Reclamation Service, the Indian Service had constructed irrigation works to water the lands of the Indians and encourage them in agriculture. These works were generally on a small scale and built under the supervision of the Indian agents and superintendents, with only occasional assistance from trained engineers. For their construction Congress has annually provided the Indian Office with funds in the Indian appropriation bill.

The passage of the reclamation act in 1902 brought the Interior Department into the work of irrigation construction on a much larger scale. The Reclamation Service was formed and drew into the service a number of irrigation engineers of broad experience, building up rapidly an organization of men trained in the work. Meanwhile the importance of the Indian irrigation work had received more recognition, resulting in the designation of an Indian Irrigation Service and the appointment of a Chief Engineer to supervise its technical work.

Thus two bureaus of the Interior Department were simultaneously building and operating irrigation systems—the Indian Service with annual appropriations in the Indian bill and the Reclamation Service on a much larger scale under the terms of the reclamation act of June 17, 1902, appropriating as a reclamation fund the receipts from the sale and disposal of public lands.

The opportunity for cooperation under these conditions was obvious, particularly to render available for the work on the Indian reservations the highly trained specialists of a larger organization, and in 1907 the Secretary of the Interior called for a plan of future cooperation. This resulted in a working agreement by which the principal engineers of the Reclamation Service were available for consultation on the Indian work, and the Chief Engineer of the Indian Irrigation Service was similarly available in connection with the reclamation projects. In a few cases the conduct of operations was transferred to the forces of the Reclamation Service. The construction of the smaller systems scattered over the many Indian reservations has been carried on by the Indian Service as before, while in the case of a few reservations where larger operations were contemplated, the operations have been conducted directly by the forces of the Reclamation Service. These forces have charge of the work on the ground and report to the Director of the Reclamation Service, who advises the Commissioner of Indian Affairs of details. The Indian Service sets the general policy to be followed and determines the rate of progress through the medium of the estimates for the annual appropriations in the Indian appropriation bill.

Under these arrangements, in addition to services of a consulting nature, the Reclamation Service has carried on specific work by its own forces on the following reservations:

Arizona, Gila River (*Pima Indians*).—A flood-water canal and distributaries were built and a transmission line run from the Salt River reclamation project, carrying power developed at Roosevelt Dam for pumping irrigation water from wells put down on the reservation. The forces engaged on the Salt River project were utilized on this work, which is referred to in previous annual reports under that project.

Montana, Blackfeet (*Blackfeet Indians.*)—Surveys and examinations led to the tentative adoption of a project comprising five irrigation systems and upward of 100,000 acres. Construction has proceeded to a point where about 45,000 acres can be served, all allotted to Indians. The project is described in detail in former annual reports and in the following pages.

Montana, Flathead (*Flathead Indians*).—Here a larger project has been taken up, embracing 150,000 acres, and water has been made available for 63,000 acres. The lands under the project have been in part opened to settlement by whites under presidential proclamation. A detailed account of operations is given in what follows and in previous annual reports.

Montana, Fort Peck (*Sioux Indians*).—A project that may embrace 150,000 acres has been initiated and actual construction done sufficient to serve about 12,000 acres, all Indian allotments. The work done each year has been described in the annual reports of the Reclamation Service and the report for the year ending June 30, 1916, follows:

MONTANA, BLACKFEET (INDIAN) PROJECT.

J. B. Bond, Project Manager, Browning, Mont.

LOCATION.

County: Teton.

Townships: 31 to 34 N., Rs. 5 to 10 W.; 29 N., R. 8 W.; 30 N., Rs. 6 to 9 W.; and 35 N., Rs. 6 and 7 W., Montana meridian.

Railroad: Great Northern.

Railroad stations and estimated population January 1, 1916: Browning, 350; Blackfoot, 50; Bombay; Seville; Cadmus; Glacier Park, 100; and Cutbank, 900.

WATER SUPPLY.

Source of water supply: Two Medicine River, Cutbank, Badger, Birch, Whitetail and Blacktail Creeks.

Area of drainage basins: 1,700 square miles.

Annual run-off in acre-feet: Cutbank Creek at Cutbank (971 square miles), 1906 to 1915, maximum, 269,000; minimum, 76,370; mean, 160,790. Two Medicine River at Family (368 square miles), 1907 to 1915, mean, 300,323. Badger Creek at Family (224 square miles), 1907 to 1915, mean, 162,640. Birch Creek at Dupuyer (155 square miles), 1907 to 1915, mean, 106,250.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which service is prepared to furnish water, season of 1916: 46,640 acres.

Area under water-right applications, season of 1915: 3,247 acres.

Area irrigated season of 1916: Estimated at 3,000 acres.

Length of irrigating season: May 1 to September 30, 153 days.

Average elevation of irrigable area: 3,850 feet above sea level.

Rainfall on irrigable area, 1909 to 1915, average, 13.40 inches; 1915, 19.11 inches.

Range of temperature on irrigable area: —44° to 100° F.

Character of soil of irrigable area: Principally rich sandy loam; some gravelly loam and gumbo.

Principal products: Hay, grain, and vegetables.

Principal markets: Great Northern Railway towns from St. Paul to the Pacific coast. Local demand for hay for stock feeding.

LANDS OPENED TO IRRIGATION.

No lands have been opened to irrigation by public notice. All lands covered by canals are allotted to Indians.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys made in 1907.

Construction work on the Two Medicine unit begun in July, 1908.

Construction of Two Medicine Lake Dam begun in June, 1911; completed August, 1913.

Construction of the Badger-Fisher unit begun in June, 1911.

Two Medicine unit, 73 per cent completed, June 30, 1916.

Badger-Fisher unit, 69 per cent completed, June 30, 1916.

Birch Creek unit, 52 per cent completed, June 30, 1916.

Entire project, 28 per cent completed, June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Blackfeet project provides for five irrigation systems on the Blackfeet Indian Reservation, as follows: (1) The Cutbank north canal system heading on the left bank of Cutbank Creek and supplying water for 20,000 acres of land north and east of the creek, 11,000 acres of which are outside of the reservation; (2) the Cutbank south canal system heading on the right bank of Cutbank Creek and supplying water for 18,000 acres of land near Carlow and Seville stations on the Great Northern Railway; (3) the Two Medicine canal systems, diverting from the left bank of the Two Medicine River and supplying water through the North Branch canal, the Spring Lake Reservoir, and the South Branch canal to 48,000 acres of land; (4) the Badger-Fisher canal system diverting water from the right bank of Badger Creek, supplying water direct through a feeder canal to 3,000 acres of land on the Piegan Flats and through the Four Horns supply canal and reservoir and the Fisher canal to 30,000 acres of land between Badger and Birch Creeks; and (5) the Birch Creek canal system, diverting from the left bank of Birch Creek, and supplying water to 3,500 acres of land between Birch and Blacktail Creeks. The United States claims all waste, seepage, spring, and percolating water arising within the project, and proposes to use such water in connection therewith.

The irrigable lands of the project are located in general in the southeastern portion of the Blackfeet Indian Reservation, adjacent to the north bank of Cutbank Creek and between Cutbank Creek and Birch Creek. Of the above irrigation plan the first development of the Two Medicine canal system is completed, including 36 miles of main canals, with headworks and other structures and a complete distributing system, with structures to deliver water to approximately 24,000 acres of land. A storage reservoir has been completed at Lower Two Medicine Lake to furnish a maximum storage of 16,000 acre-feet of water for this unit. On the Badger-Fisher unit a small canal diverts water from Badger Creek direct to approximately 3,000 acres of the Piegan Flats. A supply canal 12 miles long, delivering water to Four Horns Reservoir, has been completed. Temporary controlling works to Four Horns Lake have been completed, making available a reservoir of 4,000 acre-feet capacity. Water from this storage follows the natural channel to Blacktail Creek, from which it is diverted into the Fisher canal, designed to irrigate about 30,000 acres of the Fisher Flats. The Fisher canal is completed both as to excavation and structures to the end, at mile 30. Excavation of the lateral system is also completed to cover about 20,000 acres of allotted land. The larger structures on the canal system are completed, and the smaller structures will be built as needed. The Birch Creek canal is completed to the end of mile 6. Work of the immediate future includes the construction of a few small structures on the Fisher distribution system, the construction of the Birch Creek distribution system, and the enlargement of a portion of the Two Medicine canal. No work has been done on the Cutbank unit.

SUMMARY OF GENERAL DATA FOR BLACKFEET PROJECT TO JUNE 30, 1916.

Areas:		
Irrigable acreage when project is complete		122,500
Public land entered, June 30, 1916 (acres)	11,000	
Public land withdrawn, June 30, 1916 (acres)	50,100	
Indian land, June 30, 1916 (acres)	61,400	
Acreage service could have supplied season of 1915		26,640
Addition in fiscal year 1916		20,000
Estimated addition in fiscal year 1917		4,000
Estimated acreage service can supply July 1, 1917		50,640
Acreage actually irrigated, season of 1915		1,618
Acreage cropped under irrigation, season of 1915		1,322
Crops:		
Value of irrigated crops, season of 1915		$17,033.55
Value of irrigated crops per acre cropped		12.90
Finances:		
Estimated cost of completed project		$3,500,000.00
Total construction cost to June 30, 1916		$980,147.39
Per cent complete June 30, 1916		28
Appropriation for fiscal year 1917, total		$25,000.00
Allotment for construction, fiscal year 1917		$52,583.05
Estimated per cent complete June 30, 1917		30
Announced construction charges per acre		[1]
Unexpended balance, 1915 appropriation	$7,850.35	
Appropriation fiscal year 1916	50,000.00	
Total appropriation		$57,850.35
Expenditures during fiscal year chargeable to 1916 appropriation—		
Disbursements	$27,310.80	
Registered liabilities chargeable to 1916 appropriation	2,956.50	
		30,267.30
Unencumbered balance July 1, 1916		27,583.05

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

In accordance with instructions of the Secretary of the Interior and the agreement of March 8, 1907, between the Commissioner of Indian Affairs and the Director of the Reclamation Service, topographic surveys of irrigable lands and canal location surveys were begun by the Reclamation Service on the Blackfeet Indian Reservation in August, 1907. In July, 1908, construction work was begun on the Two Medicine main canal. This canal is designed to carry 350 second-feet. For the first development the canal was constructed for 100 second-feet capacity, with the intention of enlarging it when the demand for additional water justified the expenditure. The construction of the main canal and structures for the first development and a lateral system to irrigate about 24,000 acres was completed in the fall of 1911.

Surveys for Two Medicine Lake storage were begun in the fall of 1909. Construction of the Two Medicine Lake Dam was started in July, 1911, and was completed for 16,000 acre-feet storage in August, 1913.

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[1] Not announced.

Location surveys for the Badger-Fisher unit were begun in April, 1911. Construction of the Badger-Fisher canal system began in June, 1911. The construction work is still in progress. Up to June 30, 1916, main canals, structures, and laterals had been completed for about 22,000 acres.

Construction of the outlet works for Four Horns Lake Reservoir, to supply water for the Badger-Fisher unit, was begun in September, 1914, and was completed for the first development of 4,000 acre-feet storage in August, 1915.

On the Birch Creek unit construction was begun in August, 1915, and is still in progress. The headworks, 6 miles of main canal, and distribution system for 1,000 acres of land, have been completed.

CONSTRUCTION DURING FISCAL YEAR.

Badger-Fisher unit.—The excavation of the outlet of the Four Horns Reservoir and the construction of temporary wooden controlling works to provide 4,000 acre-feet of storage were completed. The chute drop at station 1535 of Fisher canal was completed. On the Four Horns supply canal the wood-stave siphon, 62 inches in diameter and 1,030 feet in length, with concrete inlet and outlet, was constructed.

Birch Creek unit.—On the Birch Creek unit 6 miles of main canal, concrete headworks, wasteway, 4½ miles of laterals, and a number of minor structures under this system were constructed.

SURVEYS.

Meander surveys of Four Horns Reservoir and Two Medicine Lake were completed.

ECONOMIES OF GOVERNMENT WORK.

All of the construction work on the Blackfeet project has been performed by Government forces, principally with Indian labor and teams, so that comparison with contract work can not be made.

OPERATION AND MAINTENANCE.

The Two Medicine and Piegan canals were operated during the season of 1915, and a total of 1,618 acres were irrigated. The Two Medicine canal, the Piegan canal, the Badger-Fisher system, and the Birch canal are in operation this season. About 3,000 acres are under cultivation. On account of the excessive rainfall and cool season, very little irrigation has been necessary.

Historical review, Blackfeet project.

Item.	1912	1913	1914	1915	1916
Acreage for which the service was prepared to furnish water	24,000	26,640	26,640	26,640	46,640
Acreage irrigated	....	....	675	1,618	[1]3,000
Miles of canal operated	25	....	44	65	142
Water diverted (acre-feet)	3,650	700	15,380	8,254	....
Water delivered to land (acre-feet)	41	....	4,430	2,970	....
Per acre of land irrigated (acre-feet)	....	....	....	1.83	....

[1] Estimated.

SETTLEMENT.

Land under the project has not yet been opened for settlement. About 55,000 acres have been allotted to Indians, but, except in a few cases, have not been settled upon by them or farmed.

Settlement data, Blackfeet project.

Item.	1912	1913	1914	1915	1916
Total number of farms on project	3,000	3,000	3,000	3,000	3,000
Population	(1)	(1)	(1)	(1)	(1)
Number of irrigated farms	......	......	12	18	33
Operated by owners or managers	......	......	12	16	33
Operated by tenants	......	......	......	2	......
Population	......	......	40	50	153
Number of towns	4	4	4	4	4
Population	300	300	300	375	1,425
Total population in towns and on farms	300	300	340	425	1,578
Number of schools	1	1	1	1	6
Number of churches	2	2	2	3	8
Number of banks	......	......	......	......	3

[1] Not opened.

PRINCIPAL CROPS.

The principal crops are hay, small grain, and vegetables. Timothy, alfalfa, oats, flax, barley, winter and spring wheat, potatoes, and roots do very well when given the proper care. Unusual rainfall in 1915 and 1916 has made irrigation much less necessary than usual. On account of the large amount of summer-grazing area immediately adjacent to the irrigable lands, the raising and feeding of cattle, sheep, and horses will be the most profitable industry in connection with the development of the project.

Crop report, Blackfeet (Indian) project, Montana, 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Alfalfa	52	Tons	98	1.9	$7.00	$686	$13.30
Barley	11	Bushels	321	29.0	.50	161	14.50
Garden	33	......	......	......	......	1,320	40.00
Oats	576	Bushels	19,573	34.0	.40	7,829	13.60
Potatoes	18	...do	1,676	93.0	.60	1,006	55.80
Timothy	32	Tons	58	1.8	7.00	406	12.60
Wheat	187	Bushels	3,915	21.0	.75	2,936	15.75
Wild hay	413	Tons	538	1.3	5.00	2,690	6.50
Total cropped acreage.	1,322	Total and average				17,034	12.90
Irrigated, no crop:							
Fall plowing	296						
Total irrigated acreage	1,618						

Areas.	Acres.	Farms.	Per cent of project.
Irrigable area farms reported	3,247	33	12
Irrigated area farms reported	1,618	33	7
Under water-right applications	1,618	33	7
Cropped area farms reported	1,322	33	5

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 750.]

Feature costs of Blackfeet project, to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys	....	$5,336.24
Storage system:		
Preliminary survey and designs, Spring Lake Reservoir	$1,942.68	
Preliminary survey and designs, Badger Creek Reservoir	310.92	
Preliminary survey and designs, Four Horns Reservoir	1,344.64	
Preliminary survey and designs, Lower Lake, Two Medicine Reservoir	3,067.18	
Preliminary survey and designs, Middle Lake, Two Medicine Reservoir	579.07	
Preliminary and general work	128.25	
Two Medicine Dam	134,849.96	
Four Horns Reservoir	11,405.37	
Buildings, Two Medicine Lake	3,515.98	
Administrative general expense	54.05	
		157,198.10
Canal system:		
Preliminary and general work	37,053.07	
Blacktail diversion	9,126.54	
Badger feeder canal headworks	6,067.16	
Birch Creek canal headworks	2,208.79	
Two Medicine unit headworks structure	16,757.56	
Two Medicine main canal, division 1	212,254.99	
Two Medicine main canal, division 2	45,422.60	
Fisher main canal	130,203.79	
Badger-Fisher feeder canal	99,148.16	
Birch Creek main canal	7,796.76	
Steel flume, station 192, Fisher main canal	1,066.73	
Steel flume, station 230, Fisher main canal	5,281.60	
Steel flume, station 1938, Two Medicine main canal	1,245.10	
Spring Creek Canyon flume, station 277	2,802.35	
Spring Creek Canyon flume, station 97	616.67	
Spring Creek Canyon flume, station 164	699.21	
Whitetail Creek crossing siphon	13,881.77	
Sluiceway and drop, station 316, division 1, Two Medicine main canal	619.72	
Turnouts and checks, Two Medicine unit	14,741.08	
Badger-Fisher drops	27.27	
Timber wasteway, station 7134, division 1, Two Medicine main canal	1,198.55	
Timber wasteway, station 316, division 1, Two Medicine main canal	1,282.09	
Wasteway, station 322, Fisher main canal	1,950.67	
Wasteway, station 801, Fisher main canal	1,621.74	
Wasteway, Fisher main canal	834.43	
Timber culverts, division 1, Two Medicine main canal	4,695.54	
Timber culverts, division 2, Two Medicine main canal	2,109.69	
Timber culverts, Badger-Fisher feeder canal	2,816.33	
Concrete culverts under Great Northern Railway tracks	3,409.93	
Concrete culverts, Fisher main canal	6,207.91	
Undistributed cost of plant to June 30, 1915	6,535.73	
Headquarters camp construction	2,565.82	
Administrative general expense	255.80	
		642,506.15
Lateral system:		
Preliminary and general work, Birch Creek distribution system	43.55	
Preliminary survey and design, Two Medicine distribution system	12,103.91	
Preliminary survey and design, Fisher canal distribution system	8,038.82	
Preliminary survey and design, Piegan canal distribution system	16,432.00	
Birch Creek laterals and sublaterals	506.72	
Flat bottom laterals, Fisher canal distribution system	28,718.35	
V ditch laterals, Fisher canal distribution system	10,971.20	
Lateral construction, type A, Fisher canal distribution system	12,648.30	
Lateral construction, type B, Fisher canal distribution system	6,280.91	
Turnouts and checks, Fisher canal	2,873.62	
Turnouts, lateral K, Fisher canal	1,569.58	
Turnouts, double-barrel 24-inch, Fisher canal	157.12	
Turnouts, single-barrel 18-inch, Fisher canal	860.35	
Drop, lateral K, station 0, Fisher canal	3,692.73	
Drop, lateral K, station 97, Fisher canal	2,565.88	
Drop, lateral K, station 186, Fisher canal	3,125.69	
Drop, lateral K, stations 97 and 187, Fisher canal	826.82	
Drop, lateral K, station M75, Fisher canal	3,657.57	
Drop, station NO, Fisher main canal	3,786.98	
Culverts, Piegan distribution system	381.11	
Administrative general expense	178.91	
		119,420.07

Feature costs of Blackfeet project, to June 30, 1916—Continued.

Features.	Subfeature.	Principal feature.
Permanent improvements and land:		
Buildings, all units	$11,603.98	
Roads, Fisher canal distribution system	2,836.38	
Roads, Two Medicine division	7,504.42	
Roads, Piegan distribution system	202.10	
Wells, Two Medicine division	1,552.21	
		$23,699.09
Telephone system		8,298.20
Operation and maintenance during construction (water-rental basis)		23,690.09
Plant account		1,248.62
Gross cost of construction of project to June 30, 1916		981,396.46
Less revenues earned during construction period:		
Rental of buildings	839.65	
Rental of telephones and tolls	714.60	
Contractors' freight refunds	36.04	
Other revenues, unclassified	7.50	
Profit on mess-house operations	7,950.16	
Profit on mercantile store operations	18,955.99	
Profit on hospital operations	628.33	
		29,132.27
Net cost of construction of project to June 30, 1916		952,264.19

Estimated cost of contemplated work, Blackfeet project, during fiscal year 1917.

Features.	Subfeature.	Principal feature.
Examination and surveys:		
Stream gauging	$800.00	
Lateral location	700.00	
		$1,500.00
Canal system:		
Two Medicine Canal, main canal—		
Excavation	9,796.75	
Revetment	2,000.00	
Fisher Canal, drops, chutes, and checks—		
Concrete	720.00	
Back fill	60.00	
		12,576.75
Lateral system:		
Laterals and sublaterals, excavation	2,112.00	
Minor structures	4,344.30	
		6,456.30
Permanent improvements and land:		
Purchase of right of way and improvements, Two Medicine Lake Reservoir	22,400.00	
Purchase of land for canal riders' headquarters	200.00	
		22,600.00
Telephone system: Maintenance and repair of telephone lines		600.00
Operation and maintenance during construction (water-rental basis):		
Development	200.00	
Operation	2,150.00	
Maintenance	4,450.00	
		6,800.00
Messes		1,600.00
Hospitals		450.00
Total		52,583.05

MONTANA, FLATHEAD (INDIAN) PROJECT.

E. F. Tabor,[1] project manager, St. Ignatius, Mont.

LOCATION.

Counties: Flathead, Missoula, Sanders.

Townships: 15 to 25 N., Rs. 17 to 25 W., Montana meridian.

Railroad: Northern Pacific.

Towns and estimated population, June 30, 1916: Evaro, 75; Arlee, 200; Ravalli, 125; Dixon, 250; Perma, 35; Camas, 50; Dayton, 100; Big Arm, 75; Polson, 1,700; St. Ignatius, 225; Ronan, 475; and Hot Springs, 150.

WATER SUPPLY.

Source of water supply: Flathead, Jocko, and Little Bitter Root Rivers; Mud, Crow, Post, Mission, Dry, Finley, Agency, Big Knife, Valley, and Falls Creeks; and about 60 smaller streams.

Area of drainage basin: 8,000 square miles.

Annual run-off in acre-feet of Flathead River at Polson, 1908 to 1915: Maximum, 9,740,000; minimum, 5,883,000; mean, 8,070,555.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which the service is prepared to supply water, season of 1916: 63,000 acres.

Area under water-rental applications, season 1916 (to June 30): 16,994 acres.

Length of irrigating season: May 1 to September 30, 153 days.

Average elevation of irrigable area: 3,000 feet above sea level.

Rainfall on irrigable area: At St. Ignatius (Mont.) station, 1909 to 1915, average, 17.37 inches; probably less on average irrigable area.

Range of temperature on irrigable area: —30° to 96° F.

Character of soil of irrigable area: Varies from light sandy loam to heavy clay.

Principal products: Grain, hay, vegetables, fruit, and cattle.

Principal markets: Missoula, Butte, and Anaconda, Mont., and other mining and lumber towns and camps.

LANDS OPENED FOR IRRIGATION.

Dates of public notices and orders: Proclamation of the President May 22, 1909, opened lands to filing under certain rules as to registration, etc., first filing to be May 2, 1910.

Location of lands opened: Tps. 17 to 24 N., Rs. 19 to 24 W., Montana meridian.

Present status of irrigable area opened: About 49,600 acres have been entered; 400 acres open to entry; 97,000 acres in private ownership, mostly Indian allotments held under trust patents; 5,000 acres of State lands.

Limit of area of farm units: 160 acres; average irrigable, about 40 acres.

Duty of water: Works will provide about 1.5 acre-feet per acre per annum at the farm.

Building charges: Not fixed.

Annual operation and maintenance charges: $1 per acre-foot; minimum charge, $1 per acre, 1916.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys begun in 1907.

Construction authorized and first appropriation made by act of Congress approved April 30, 1908.

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[1] Died August 20, 1916. F. T. Crowe appointed project manager.

Irrigation in Jocko and Mission divisions begun in 1910.
Irrigation in Post division begun in 1911.
Kickinghorse feeder canal completed in 1912.
Irrigation in Polson and Pablo divisions begun in 1913.
Entire project 26.1 per cent completed June 30, 1916.

IRRIGATION PLAN.

The irrigation plan of the Flathead project provides for the irrigation of about 152,000 acres of land in various parts of what was the Flathead Indian Reservation, water being diverted from creeks and rivers rising in the Mission Mountains and conducted by canals directly to the land and to reservoirs for the storage of flood waters. About 12 reservoirs will be constructed. Some of these are lakes, the capacity of which will increase, and others natural basins, which will require only the building of embankments at low points. The water supply will be supplemented when necessary by pumping from Flathead Lake. Irrigable tracts on the Jocko, Mission, Post, Pablo, and Polson divisions, which contain the largest percentage of irrigable land allotted to the Indians, have been selected for the first development. The United States claims all waste, seepage, spring, and percolating water arising within the project and proposes to use such water in connection therewith.

The following principal features have been completed: A distribution system covering approximately 8,500 acres in Jocko Valley, taking water from Jocko River and tributaries; a distribution system covering about 6,600 acres and taking water from Mission Creek; a distribution system lying below Kickinghorse Dam site, covering about 2,000 acres; a distribution system lying under the Ninepipe Reservoir, covering about 21,500 acres, which, together with the previous-mentioned tract, takes water from Post Creek and tributaries; a distribution system taking water from Crow Creek for about 2,000 acres in Moiese Valley; a distribution system under Pablo Reservoir, taking water from Post, Crow, and Mud Creeks for about 21,200 acres; and a distribution system taking water from the last-named creeks for about 1,200 acres near Polson. Two storage reservoirs have been constructed—Pablo Reservoir for 5,000 acre-feet and Ninepipe for 5,000 acre-feet. Canals have been dug, but structures are incomplete for an additional area of about 15,000 acres. Contract has been let for the major part of this structure work. The Pablo Feeder Canal has been built from 2 miles south of Post Creek to Pablo Reservoirs, a distance of about 29 miles, picking up the waters of all streams flowing from the mountains.

SUMMARY OF GENERAL DATA FOR FLATHEAD PROJECT TO JUNE 30, 1916.

Areas:		
Irrigable acreage when project is complete		152,000
Public land entered June 30, 1916 (acres)	47,000	
Public land open to entry June 30, 1916 (acres)	500	
Public land withdrawn June 30, 1916 (acres)	7,500	
State land June 30, 1916 (acres)	11,000	
Indian land June 30, 1916 (acres)	85,010	
Private land June 30, 1916 (acres)	990	
Acreage service could have supplied season of 1915		52,400
Addition in fiscal year 1916		13,600
Estimated addition in fiscal year 1917		28,700
Estimated acreage service can supply July 1, 1917		94,700
Acreage actually irrigated, season of 1915		3,242
Acreage cropped under irrigation, season of 1915		3,179
Crops:		
Value of irrigated crops, season of 1915		$48,627.87
Value of irrigated crops, per acre cropped		15.19
Finances:		
Estimated cost of completed project		$6,790,009.68
Total construction cost to June 30, 1916		$1,676,292.46
Per cent complete, June 30, 1916		26.1
Apropriation for fiscal year 1917, total		$750,000.00
Allotment for construction, fiscal year 1917		$700,000.00
Estimated per cent complete, June 30, 1917		33.5

Apropriation, fiscal year 1916		$200,000.00	
Unexpended balance of 1915 appropriation		192,442.88	
Total appropriation			$392,442.88
Expenditures during fiscal year, chargeable to 1916 appropriation:			
Disbursements	$244,180.85		
Transfers	956.89		
		$245,137.74	
Registered liabilities chargeable to 1916 appropriation		31,146.92	
Contract obligations wholly covered by 1916 appropriation		70,640.19	
			$346,924.85
Unencumbered balance July 1, 1916			$45,518.03
Repayments:			
Water rental charges accrued to June 30, 1916			30,784.22
Collected to June 30, 1916		$17,999.40	
Uncollected June 30, 1916		12,784.82	
Drainage:			
Estimated acreage damaged by seepage to June 30, 1916			360
Miles of drains built to June 30, 1916—			
Open		0.18	
Closed		1.47	
Total			1.65
Estimated acreage protected by drains built to June 30, 1916			540
Estimated acreage to be protected by authorized system			700
Expended, to June 30, 1916, on drainage works completed and uncompleted			$23,599.06

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

INVESTIGATIONS AND PLANS.

In letter dated April 26, 1907, the Office of Indian Affairs requested that the Reclamation Service undertake investigations of water supply and lands to be irrigated on the Flathead Indian Reservation. In July, 1907, field surveys and investigations of possible reservoir sites were begun. The gauging of some of the streams from which the project might secure water was also undertaken. A report of the investigations of the season and recommendations for the beginning of work on certain parts of the project were made in November, 1907. Congress, by act approved April 30, 1908, appropriated $50,000 for surveys and the beginning of construction work. Under this appropriation a general survey of the reservation was begun and plans made for the beginning of construction work on certain parts of the project. The general plans for canal systems and reservoirs were considered and approved by W. H. Code, chief engineer, Indian irrigation, and W. H. Sanders, consulting engineer for the Reclamation Service.

1909.

Actual construction work was begun in Jocko division in the spring of 1909, and about 5,000 acres of land brought under irrigation. During the same year, Mission lateral B was completed, serving a similar area. About 5 miles of lateral B were constructed in Polson division. Topographic curveys were extended during the year to cover most of the irrigable area east of Flathead River.

On April 27, 1909, a board of engineers, consisting of Messrs. H. N. Savage, H. A. Storrs, R. O. Hayt, and E. F. Tabor, met at Polson to consider the general plans for Newell Tunnel. Test pits were sunk to disclose the character of the foundation for the power house, so that final location was not made until June 5, 1909. A 5 by 12 foot shaft, 76 feet deep, was sunk near the inlet in the fall of 1909, and actual driving of the tunnel was started December 8. The tunnel was completed to the shaft, a distance of 1,703 feet, December 27, 1911.

1910.

In the year 1910, Jocko lateral K was completed and lateral D out of Big Knife Creek was constructed, bringing a total of about 8,000 acres of land under laterals in this division. Laterals B and C, Post division, commanding about 7,000 acres of land, were constructed during the summer months and work was begun on Ninepipe Dam. The headworks and diversion dam for Kickinghorse feeder canal on Post Creek were completed ready for the installation of gates. Twenty-two miles of the Pablo lateral A system were also completed.

1911.

The Finley Creek system of laterals in Jocko division was excavacated by Government forces during the season of 1911. No structures were built except the headgates. In Mission division a permanent camp was constructed at St. Mary Lake, a telephone line and road were built to the camp, and a number of test pits were sunk to determine the best location for the tunnel and dam. General plans for the tunnel and dam were considered by boards of engineers as follows: H. N. Savage, Charles P. Williams, Joseph Wright, and E. F. Tabor, August 17 and 18; A. P. Davis and H. N. Savage, September 2; F. H. Newell, H. N. Savage, C. J. Moody, and E. F. Tabor, October 11; D. C. Henny, C. J. Moody, and E. F. Tabor, December 17, 1911. Actual construction work has not been started. In Post division, the Kickinghorse feeder canal was constructed by steam shovel, and the concrete drops into Kickinghorse Reservoir were built. The supply canal between the Kickinghorse and Ninepipe Reservoirs was excavated, but the three drops required for this line were not constructed. The lateral system was extended to serve a total of about 16,000 acres, with the exception of turnouts and measuring devices. The embankments of Ninepipe Dam were raised to elevation 3007, which will store about 5,350 acre-feet. The Pablo feeder canal was completed to Post Creek, including necessary headworks, wasteways, bridges, and drops, except Post Creek headworks. Government forces also constructed the drops into North, Middle, and South Pablo Reservoirs, the North and South Pablo controlling works, and about 8 miles of lateral extensions. The first contract construction work on the project was awarded to Nelson Rich for the initial development of North, Middle, and South Pablo Dams and the excavation of supply canals and 6 miles of lateral A. The contractor started work October 1, 1911. Consulting Engineer D. C. Henny and Supervising Engineer H. N. Savage met with Project Manager E. F. Tabor on May 18 and again on July 1, 1911, to revise plans for South Pablo controlling works.

1912.

In the year 1912 the Northern Pacific Railway constructed a culvert under their track for lateral E in Jocko division. In Post division, Government forces practically completed the excavation of lateral A and excavated about 15,000 cubic yards on lateral G. Timber structures were built on laterals wherever water applications indicated their immediate use. The steam-shovel excavation on the Pablo feeder canal was extended about a mile south of Post Creek; work was discontinued, on account of lack of funds, April 12, 1912, and has not since been resumed. Government forces constructed Post Creek headworks, Pablo lateral X, and a number of timber and concrete structures on Pablo lateral A and sublaterals. Contractor Nelson Rich constructed the North and Middle Pablo Dams, started the South Pablo Dam, and practically completed the supply canals.

1913.

In the year 1913, Post MA lateral was excavated to station 93 by steam shovel. The headworks, several of the other structures, and part of the lateral system were built by Government forces. In Pablo division, Government forces constructed 252 structures on laterals X and A. Contractor Nelson·Rich completed the construction of the Pablo dams and canals. The work was inspected on May 21 by Messrs. Charles P. Williams and D. C. Henny; June 8, by Messrs. H. N. Savage, George O. Sanford, and E. F. Tabor; and on July 19 by Messrs. A. P. Davis, H. N. Savage, and E. F. Tabor. Wilson Bros. moved about 11,300 cubic yards of excavation on Pablo lateral 31A during November and December. In Polson division, the excavation of lateral E and the placing of timber structures on laterals B and E were done by Government forces. A board of engineers, consisting of Messrs. H. N. Savage, Charles P. Williams, and E. F. Tabor, met at Great Falls, Mont., on July 25, 1913, to consider proposed work.

1914.

In the year 1914, Post MA lateral was completed to station 284+50 by steam shovel. Sublaterals and structures were completed to serve about 3,000 acres in the Moiese Valley. Operation and maintenance forces placed 305 minor structures, principally turnout and measuring devices, in all divisions. Wilson Bros. completed the excavation of Pablo laterals A (station 440 to 800) and 31A. Nelson Rich constructed the Pablo lateral 31A tunnel, which will deliver a maximum of 200 second-feet to lateral 31A. Four thousand four hundred square yards of 18-inch paving were placed on the South Pablo Dam, with a resultant storage capacity of 1,800 acre-feet.

1915.

In the year 1915, Wilson Bros. partially constructed Mission lateral H, and completed the work in the spring of 1916. They also placed 1,710 square yards of paving on South Pablo Dam, with a resultant storage of 3,100 acre-feet, and constructed Pablo laterals 7P and 8Z.

The Two Miracle Concrete Corporation completed the structures on Pablo laterals A (station 440 to 800) and 31A. The excavation of lateral 73A was done by A. L. Markhus, and the structures were built by J. E. Hilton. The Government drag-line constructed 4,500 linear feet of 12 by 26 inch timber drain on the Polson drainage system. In connection with this work, a board of engineers, consisting of Messrs. D. W. Murphy, Charles P. Williams, and E. F. Tabor, met at St. Ignatius, Mont., April 22, 1915.

CONSTRUCTION DURING FISCAL YEAR.

Jocko division.—The inlet, outlet, concrete elbow, and bridge for the Jocko River Crossing were built by Government forces. The 42-inch wood-stave pipe for the crossing was placed by contract. A contract was awarded for the building of structures on the Finley Creek system, covering about 5,000 acres, and work was 73 per cent complete at the end of the fiscal year.

Mission division.—The construction of Mission lateral H system was completed June 6, for conveying water to the new Flatland Agency grounds and adjoining farm units and allotments. Contract work for small lateral extensions was completed June 15, 1916.

Post division.—The only construction on this division was under contract for small lateral extensions, work under which was 15 per cent complete June 30, 1916.

Pablo division.—The excavation of 73A lateral system was completed July 21, 1915. The structures on laterals A, 31A, and 73A were built under contract, and also the earthwork and structures on laterals 7P and 8Z; small lateral extensions were completed June 15, 1916. The construction of laterals as noted above has placed 14,000 additional acres under completed works on this division. The excavation of the By-Pass canal in the North Pablo Reservoir was 97 per cent complete on June 30, 1916. Horte Dam was constructed by Government forces; it will impound 260 acre-feet of water.

Polson division.—The main drain in the Polson drainage system—7,100 feet in length—was excavated with the old dragline excavator and the wooden box drain laid. A new Monighan caterpillar dragline excavator was purchased and started on the excavation of the branch drains.

OPERATION AND MAINTENANCE.

During the calendar year 1915 fewer water-rental applications were received and less land was irrigated than in 1914. This was due almost wholly to the amount of rainfall, which was, in general, sufficient for grain crops without irrigation. The precipitation for 1915 was 21.88 inches at St. Ignatius, which is 4.48 inches in excess of the average for seven years. The number of applications received was 249, representing an irrigable area of 14,268 acres. Only 185 farms were irrigated, representing an irrigable area of 10,083 acres. The land actually irrigated in 1915 amounted to 3,242 acres, on which 3,637 acre-feet of water were used, or an average of 1.12 acre-feet per acre. As the principal crops watered were grain and pasture, the average of 1.12 acre-feet proved sufficient. The system of rotation between laterals or periodic delivery was continued. The spring of 1916 was unusually cool and crops were correspondingly late. Up to the end of the fiscal year 307 applications for water had been approved and 2,575 acres of land had been irrigated.

Historical review, Flathead project.

Item.	1911	1912	1913	1914	1915	1916 (to June 30).
Acreage for which service was prepared to supply water.	19,000	35,000	42,400	48,900	52,400	63,000
Acreage irrigated	2,369	4,203	4,631	6,416	3,242	2,575
Miles of canal operated	46	103	180	233	201	204
Water diverted (acre-feet)	10,940	21,875	22,945	46,329	21,029	4,654
Water delivered to the land (acre-feet)	4,719	8,344	6,104	8,752	3,637	2,031
Per acre of land irrigated (acre-feet)	1.99	1.98	1.30	1.36	1.12	0.79

SETTLEMENT.

A number of tracts of Indian land have been sold and a number of homesteads have changed hands. In this way new settlers have come to the project and have begun improvements. The towns show some growth, with business conditions good. A number of buildings have been erected at Polson, including a church and a garage; St. Ignatius has added several residences and business buildings, including a garage, and a new grain elevator has been erected at Ravalli.

Settlement data, Flathead project.

Item.	1912	1913	1914	1915	1916 (to June 30).
Total number of farms on project (irrigable)[1]	2,980	2,980	2,980	2,980	2,980
Population	8,000	8,400	13,855	14,000	[3] 14,000
Number of irrigated farms	111	155	223	185	303
Operated by owners or managers	84	127	188	159	219
Operated by tenants	27	28	35	26	84
Population	([2])	([2])	578	433	627
Number of towns	10	10	10	11	12
Population	([2])	([2])	2,842	3,147	3,460
Total population in towns and on farms	([2])	([2])	16,697	17,147	17,460
Number of public schools	....	....	36	48	51
Number of churches	....	....	14	14	15
Number of banks	....	....	9	9	9
Total capital stock	....	....	$205,000	$205,000	$205,000
Total amount of deposits	....	....	$535,870	$495,000	$745,733
Total number of depositors	....	....	2,614	2,603	3,669

[1] Includes both irrigated and "dry" farms on project. [2] Included in second item. [3] Estimated.

PRINCIPAL CROPS.

Crop conditions during the season of 1915 were good. There was an increase of $2.13 per acre in the average crop value over that of 1914. The yield and value of alfalfa hay are underrated, due to many farmers cutting only one crop and pasturing during the rest of the season. A maximum yield of 4.8 tons per acre is reported. There is a considerable increase in live stock on the farms, and more interest is being manifested in dairy cattle.

Crop report, Flathead (Indian) project, Montana, 1915.

Irrigated crop.	Area (acres).	Unit of yield.	Yield.		Value.		
			Total.	Average per acre.	Per unit.	Total.	Per acre.
Alfalfa hay	297	Tons	510.78	1.7	$10.00	$5,108	$17.30
Apples	1	Pounds	280.00	500.0	.02	5	10.00
Barley	30	Bushels	650.00	22.1	.50	325	11.01
Beans	4	...do	25.00	5.7	2.00	50	11.52
Clover hay	454	Tons	699.05	1.5	8.00	5,592	12.30
Corn	1	Bushels	16.00	40.0	.50	8	20.00
Corn fodder	12	Tons	6.16	1.5	6.00	37	3.03
Clover seed	109	Bushels	60.00	.5	10.00	600	5.50
Garden	69	Acres		53.3	53.30	3,689	53.30
Hay	370	Tons	526.44	1.4	8.00	4,211	11.36
Oats	893	Bushels	35,289.00	39.7	.31	10,940	12.25
Pasture	1,395	Acres			1.52	2,126	1.52
Peas	14	Bushels	48.00	3.4	2.00	96	6.87
Potatoes	18	...do	3,030.00	162.4	.39	1,182	63.40
Rape	5	Tons	2.36	.5	6.00	15	3.03
Wheat	874	Bushels	15,870.00	18.2	.90	14,263	16.34
Less duplicated	1,368						
Total cropped acreage.	3,179	Total and average				48,268	15.19
Irrigated, no crop:							
Young orchard	28						
Young alfalfa	45						
Young clover	82						
Miscellaneous	18						
Less duplicated areas	110						
Grand total irrigated.	3,242						

Areas.	Acres.	Farms.	Per cent of project.
Irrigable area farms reported	10,083	185	6.63
Irrigated area farms reported	3,242	185	2.13
Under rental contract	3,242	185	2.13
Cropped area farms reported	8,320	185	5.47

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 751.]

Feature costs of Flathead project to June 30, 1916.

Features.	Subfeature.	Principal feature.
Examination and surveys		$41,254.92
Storage system:		
Mission division	$14,288.60	
Post division	120,890.29	
Pablo division	228,146.39	
Polson division	490.15	
Camas division	1,146.67	
		364,962.19
Canal system: Pablo feeder and by-pass canal		254,371.03
Lateral system:		
Jocko division	144,786.10	
Mission division	69,435.78	
Post division	285,175.27	
Crow division	5,500.00	
Pablo division	324,307.37	
Polson division	15,446.12	
Camas division	1,187.88	
Administrative and general expenses undistributed	5,872.07	
		851,710.14
Drainage system: Polson division (Polson drain)		23,599.06
Power system: Polson division (Newell tunnel)		101,685.11
Farm units		15,346.31
Permanent improvements and lands:		
Headquarters buildings	4,010.00	
Mission division	10,118.49	
Post division	751.88	
Pablo division	7.50	
		14,917.87

Feature costs of Flathead project to June 30, 1916—Continued.

Features.	Subfeature.	Principal feature.
Telephone system (project as a whole)		$8,445.38
Operation and maintenance during construction (water rental basis)		98,288.20
Plant accounts		26,677.66
Gross cost of construction of project to June 30, 1916		1,801,257.87
Less revenues earned during construction period:		
Rental of buildings	$3,555.47	
Rental of grazing and farming lands	810.75	
Rentals of irrigation water	29,675.02	
Rentals of telephones and tolls	5,104.96	
Contractors' freight refunds	2,072.04	
Forfeitures by defaulting bidders and contractors	990.00	
Other revenues, unclassified	344.19	
Profit on mess house operations	12,097.51	
Profit on mercantile store operations	8,525.50	
Profit on hospital operations	1,146.79	
Amounts set up as reserves or depreciation charged to cost and not expended		64,322.23
Net cost of construction of project to June 30, 1916		1,736,935.64

Estimated cost of contemplated work, Flathead project, during fiscal year 1917.

Features.	Sub-feature.	Principal feature.
Examination and surveys:		
Preliminary and general	$1,000	
Topographic surveys	5,000	
Hydrographic records	2,000	
Lateral location surveys	1,000	
Damages to land	400	$9,400
Storage system:		
Preliminary and general	4,000	
South Pablo Dam	5,600	
McDonald Dam and spillway	28,000	
Little Bitter Root Lake Dam	7,500	
Hubbart Dam	52,000	
St. Mary Tunnel	78,900	176,000
Canal system:		
Preliminary and general	2,000	
Diversion dam and headworks	4,000	
Main canal	83,700	
Flumes	15,500	
Wasteways	1,200	106,400
Lateral system:		
Preliminary and general work	18,000	
Headworks	10,000	
Laterals and sublaterals	278,200	
Drops	5,000	
Siphons	8,000	319,200
Drainage system:		
Preliminary and general work	500	
Open drains	500	
Closed drains	9,000	10,000
Farm units		11,700
Permanent improvements and land:		
Buildings	11,500	
Real estate and improvements	1,000	12,500
Telephone system:		
Preliminary and general work	300	
Telephone lines	7,070	7,370
Operation and maintenance during construction (water rental basis)		47,430
Messes		45,000
Mercantile stores		3,000
Hospitals		2,000
Total		750,000

MONTANA, FORT PECK (INDIAN) PROJECT.

R. M. CONNER, project manager, Poplar, Mont.

LOCATION.

Counties: Valley, Sheridan.

Townships: 26 to 33 N., Rs. 39 to 56 E., Montana meridian.

Railroads: Great Northern.

Railroad stations and estimated population January 1, 1916: Wiota;[1] Kintyre;[1] Frazer, 50; Oswego, 250; Lohmiller;[1] Wolf Point, 700; Chelsea;[1] Poplar, 1,000; Sprole;[1] Brockton, 200; Calais;[1] and Blair.[1]

WATER SUPPLY.

Source of water supply: Missouri and Poplar Rivers; Little Porcupine, Big Porcupine, Wolf, Smoke, and Big Muddy Creeks.

Area of drainage basins: Missouri River, 85,000 square miles; Poplar River, 3,000 square miles; Big Porcupine Creek, 683 square miles.

Annual run-off in acre-feet (1909–1915): Poplar River, mean, 52,600; Big Porcupine Creek, mean, 13,460; Little Porcupine Creek, mean, 3,700; Wolf Creek at Wolf Point, mean, 5,360; Big Muddy Creek near Culbertson, mean, 23,100.

AGRICULTURAL AND CLIMATIC CONDITIONS.

Area for which service is prepared to supply water, season of 1916: Little Porcupine unit, 2,330 acres; Poplar River unit, 10,290 acres.

Area irrigated, season of 1916: 910 acres to June 30, 1916.

Length of irrigating season: From April 1 to August 31, 153 days.

Average elevation of irrigable area: 2,000 feet above sea level.

Rainfall on irrigable area: 1896 to 1915, average, 14.26 inches; 1915, 10.81 inches.

Range of temperature on irrigable area: —40° to 100° F.

Character of soil of irrigable area: Heavy clay and loam.

Principal products: Hay, grain, and vegetables.

Principal markets: Local and Minneapolis and St. Paul.

LAND OPEN FOR IRRIGATION.

In the construction of the systems laterals are being constructed to the alloted areas only. The work of allotting has been completed, but a few changes are being made. The allotted area in each unit is as follows: Big Porcupine, 6,400 acres; Little Porcupine, 2,330 acres; Missouri River, 38,000 acres; Poplar River, 11,600 acres; Big Muddy, 12,900 acres. Under the Poplar River 80 acres of land under the canals have been sold to whites.

CHRONOLOGICAL SUMMARY.

Reconnoissance and preliminary surveys made in 1908.

Little Porcupine unit completed to allotted irrigable area in July, 1911.

Construction work on project discontinued temporarily July 31, 1911, and resumed October 10, 1912.

Entire project 9.7 per cent completed June 30, 1916.

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[1] Population less than 25.

IRRIGATION PLAN.

The irrigation plan for the Fort Peck project provides, in so far as the water supply is found sufficient, for the irrigation of lands in various parts of the Fort Peck Indian Reservation and adjacent territory as follows: (1) 4,000 acres in the vicinity of Wiota station, with flood waters from Big Porcupine Creek; (2) 2,000 acres in the vicinity of Frazer, with water supply from Little Porcupine Creek conserved by storage; (3) 28,000 acres in the vicinity of Poplar and extending along Poplar River a distance of 35 miles, with water supply from Poplar River conserved by storage below the forks of Poplar and West Branch; (4) 16,000 acres lying along the west side of Big Muddy Creek, with water supply from Big Muddy Creek conserved by storage on Smoke and Wolf Creeks; (5) 50,000 acres of clear bench land and approximately 34,000 acres of brush and timber land extending along the Missouri River, with water supply from the Missouri River by a gravity canal heading near the site of old Fort Peck; (6) 10,000 acres, known as the Galpin Bottom, lying above the Missouri River canal west of Milk River and Fort Peck Indian Reservation, with water supply by pumping from the Missouri River canal, with a lift of about 20 feet; (7) 8,000 acres lying above the Missouri River canal, east of Milk River, in the Fort Peck Indian Reservation, with water supply from pumping from the Missouri River canal, with a lift of from 10 to 20 feet. The United States claims all waste, seepage, spring, and percolating water arising within the project and proposes to use such water in connection therewith.

The Little Porcupine unit, with storage reservoir of 3,900 acre-feet, has been completed to irrigate 2,330 acres. Poplar River west canal B has been completed to irrigate 2,560 acres of allotted area, and Poplar River east canal C, to irrigate 5,330 acres of allotted land, is 98 per cent completed. The Big Porcupine Creek canal, to irrigate 4,000 acres of allotted land on the west boundary of the reservation, is 95 per cent completed.

It is proposed during the next fiscal year to complete the Big Porcupine unit to the first 4,000 acres and to construct a storage reservoir of 3,800 acre-feet capacity on the Middle Fork of Big Porcupine Creek; to extend the lateral system under the Poplar River unit to new allotments; and to construct a drop in the diversion canal to Little Porcupine Reservoir and additional farm turnouts under the Little Porcupine unit. Future work will include the construction of the Big Muddy unit to 12,900 acres of allotted land and the construction of reservoirs for this unit on Smoke and Wolf Creeks; the construction of a reservoir on Poplar River; and the construction of the Missouri River canal to irrigate 37,900 acres of allotted land along the Missouri River and adjacent to the Great Northern Railway, where the larger percentage of Indians have their homes.

SUMMARY OF GENERAL DATA FOR FORT PECK PROJECT TO JUNE 30, 1916.

Areas:		
Irrigable acerage when project is complete		152,000
Public land entered June 30, 1916 (acres)	9,713	
Public land open to entry June 30, 1916 (acres)	107	
State land June 30, 1916 (acres)	180	
Indian land June 30, 1916 (acres)	141,920	
Private land, June 30, 1916	80	
Acreage service could have supplied season of 1915		12,620
Estimated addition in fiscal year 1917		4,000
Estimated acreage service can supply July 1, 1917		16,620
Acreage actually irrigated, season of 1915		1,100
Acreage cropped under irrigation, season of 1915		995
Crops:		
Value of irrigated crops, season of 1915		$10,681.13
Value of irrigated crops, per acre cropped		10.73
Finances:		
Estimated cost of completed project		$5,220,000
Total construction cost to June 30, 1916		$485,293.55
Percent complete June 30, 1916		9.7
Appropriation for fiscal year 1917, total		$100,000
Allotment for construction fiscal year 1917		$110,000
Estimated per cent complete June 30, 1917		11.4

Finances—Continued.

Appropriation fiscal year 1916		$50.000.00	
Unexpended balance of 1915 appropriation		6,764.18	
Total appropriation			$56,764.18
Expenditures during fiscal year, chargeable to 1916 appropriation—			
Disbursements	$33,258.60		
Transfers	161.79		
		33,420.39	
Registered liabilities chargeable to 1916 appropriation		4,481.96	
			37,902.35
Unencumbered balance July 1, 1916			18,861.83

HISTORY OF CONSTRUCTION AND ENGINEERING FEATURES.

In July, 1908, investigation and surveys of the Fort Peck project were begun by the Reclamation Service. Reconnoissance, topographic surveys, and investigation of storage sites and power possibilities have been made. In August, 1909, the project was visited by the chief engineer of the Indian Department, Mr. Code, and H. N. Savage, the supervising engineer of the northern division of the Reclamation Service. As a result of this investigation the immediate construction of the Missouri River canal was proposed and work begun in September on the construction of the Little Porcupine unit. The construction of the Poplar River unit was begun in October, 1910. This work was continued until August, 1911, when construction was stopped on account of lack of funds. Construction was again resumed in September, 1912. The Big Porcupine unit was undertaken in September, 1914, and work was continued until December, 1914, and resumed again in July, 1915, when additional funds were available.

CONSTRUCTION DURING FISCAL YEAR.

The appropriation of $50,000 for the fiscal year 1916 was expended on the construction of the remaining laterals and completion of the diversion dam, three flumes, two drops, and a large number of minor structures for the Big Porcupine Creek canal, the construction of checks and turnouts for the Poplar River unit, and the operation and maintenance of the Poplar River and Little Porcupine units.

SEEPAGE AND DRAINAGE.

No serious seepage has occurred on the project and no drainage work has been necessary.

ECONOMIES OF GOVERNMENT WORK.

Under the plan of construction for this project it has been the policy to employ Indian labor as far as possible. At first this method was rather expensive because of the inexperience of the Indians in this class of work and the poor condition of their stock. This has been remedied to a large extent and the Indians have improved as workmen and have obtained better horses, partly from money earned on the work.

In the construction of minor structures, such as farm and lateral turnouts and culverts, a large amount of concrete pipe has been manufactured locally at the following cost per foot, including cement: 15-inch pipe, 40 cents; 18-inch pipe, 55 cents; 24-inch pipe, 75 cents; 36-inch pipe, $1.30. The pipe manufactured was made by the wet process, which results in a pipe much superior to that made by the dry process.

OPERATION AND MAINTENANCE.

Water was available for irrigation for the Little Porcupine unit in 1912, but owing to the excessive rainfall which occurred during the growing season no water was delivered to the land. During 1913 a small acreage was irrigated under the Little Porcupine unit and a few acres under the Poplar River west canal. There was urgent need of irrigation in 1913, but on account of the wet season of 1912 and the large crops obtained by dry farming it was difficult to persuade any of the Indians to use water. The acreage irrigated during 1914 was 1,004 acres, or about one-tenth of the land under completed canals.

During 1915, 1,100 acres were irrigated. The rainfall was below normal, but the temperature during June and July was very low and exceptional crops were grown without irrigation. No money was available to operate the canals during April and May of 1915, and a considerable acreage under the Poplar River unit would have been irrigated had water been available during the early months. The Indians under the Little Porcupine unit, during April, 1915, cleaned the canals of weeds and did other work necessary to put this unit into operation when funds were not available for the work.

During the spring of 1916 the excessive run-off from the area above the canal caused considerable damage to the canal banks, but as soon as the canals could be put into operation the delivery of water was begun. Up to the end of the fiscal year 910 acres had been irrigated and a considerable additional acreage had been prepared for irrigation of grain a little later in the season. Sixteen new allotments have been occupied under the Poplar River unit and a large acreage plowed and put into flax which will be available for irrigation during 1917.

Historical review, Fort Peck project.

Item.	1913	1914	1915	1916
Acreage for which service was prepared to supply water	4,970	10,220	12,620	12,620
Acreage irrigated	410	1,004	1,100	[1] 1,500
Miles of canals operated	30	85	85	85
Water diverted (acre-feet)	800	2,000	3,600	[1] 3,500
Water delivered to land (acre-feet)	800	2,000	1,560	[1] 2,250
Per acre of land irrigated (acre-feet)	1.9	2.0	1.42	[1] 1.5

[1] Estimated.

SETTLEMENT.

In the spring of 1914 the grazing land on the reservation was opened to entry through a drawing in September, 1913. The settlement of this land was relatively slow during 1914 and 1915, but during the spring of 1916 a large number of entries were made, until the desirable land was well taken up. A few of the Indians have received title to their land, and a few irrigable allotments have changed hands at prices ranging from $25 to $30 per acre. Under the Poplar River unit the Indians are moving onto their irrigable allotments and establishing homes. In some cases they have sold a portion of their grazing land, and used the money to fence and put down wells and establish themselves on their irrigable allotments.

Settlement data, Fort Peck project.

Item.	1913	1914	1915	1916
Total number of allotments on project (irrigable)	....	1,780	1,780	1,780
Population (Indians)	1,991	1,991	2,046	2,092
Number of irrigated farms	18	29	42	[1] 48
Operated by owners or managers	18	26	40	[1] 46
Operated by tenants	....	3	2	2
Population	50	70	110	[1] 130
Number of towns	5	5	5	5
Population, white	980	1,440	1,780	2,200
Total population in towns and on farms	2,971	3,431	3,826	4,292
Number of schools:				
Indian	5	5	5	5
White	1	2	3	5
Number of churches	5	6	7	7
Number of banks	3	4	5	4
Total capital stock	$65,000	$85,000	$105,000	$110,000
Total amount of deposits	$160,000	$223,000	$234,000	$477,000
Total number of depositors	900	1,250	1,400	1,970

[1] Estimated.

PRINCIPAL CROPS.

The principal crops raised on the reservation are oats, wheat, flax, vegetables, and a large tonnage of blue-joint hay. There is an increased acreage each year under the irrigation canals and on dry farming. The greater part of the Indians have their homes along the Missouri River, and they try to farm on the dry land. In 1912 good crops were obtained over this area, but for the last two years the results have not been satisfactory. Several Indians have recently moved to the Poplar River and begun farming on the irrigable area.

Crop report, Fort Peck (Indian) project, Montana, year of 1915.

Crop.	Area (acres).	Unit of yield.	Yields.		Values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
Wheat	175	Bushels	2,176	12.4	$0.90	$1,959	$11.13
Oats	142	...do	3,551	25.0	.38	1,349	9.50
Barley	30	...do	417	13.9	.55	229	7.64
Hay	640	Tons	843	1.32	8.00	6,744	10.54
Garden	8	....	....	....	....	400	50.00
Total cropped acreage.	995	Total and average				10,681	10.73
Irrigated, no crop	105						
Total irrigated acreage	1,100						

FINANCIAL STATEMENT.

[Financial statement in detail, showing assets, liabilities, reserves, and capital, given in appendix, p. 752.]

Feature costs of Fort Peck project to June 30, 1916.

Features.	Sub-features.	Principal features.
Exmination and surveys		$32,133.97
Storage works:		
Little Porcupine unit	$28,785.00	
Big Porcupine unit	87.10	28,872.10
Canal system:		
Poplar River unit	206,165.64	
Big Porcupine unit	62,738.30	
Big Muddy unit	654.53	269,558.47
Lateral system:		
Little Porcupine unit	24,210.48	
Poplar River unit	54,299.00	
Big Porcupine unit	53,461.44	
Big Muddy unit	436.34	132,407.26
Permanent improvements and land: Project buildings		7,737.20
Operation and maintenance during construction (water rental basis)		14,584.55
Plant accounts		10,570.07
Gross cost of construction of project to June 30, 1916		495,863.62
Less revenues earned during construction period:		
Rental of buildings	1,104.31	
Loss on mess house operations	[1] 434.57	
Profit on mercantile store operations	9,136.88	
Profit on hospital operations	408.34	10,214.96
Net cost of construction of project to June 30, 1916		485,648.66

[1] Deduct.

Estimated cost of contemplated work, Fort Peck project, during fiscal year 1917.

Features.	Sub-features.	Principal features.
Storage works:		
Big Porcupine unit (storage dam)	$68,900.00	
Little Porcupine unit	1,200.00	$70,100.00
Canal system:		
Poplar River unit	5,000.00	
Big Muddy unit	5,000.00	10,000.00
Lateral system:		
Little Porcupine unit	740.00	
Poplar River unit	1,440.00	
Big Porcupine unit	18,620.00	20,800.00
Operation and maintenance during construction (water rental basis)		10,000.00
Total		110,900.00

APPENDIX.

LEGISLATION.

RECLAMATION ACT.

An Act Appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That all moneys received from the sale and disposal of public lands in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming, beginning with the fiscal year ending June thirtieth, nineteen hundred and one, including the surplus of fees and commissions in excess of allowances to registers and receivers, and excepting the five per centum of the proceeds of the sales of public lands in the above States set aside by law for educational and other purposes, shall be, and the same are hereby, reserved, set aside, and appropriated as a special fund in the Treasury to be known as the "reclamation fund," to be used in the examination and survey for and the construction and maintenance of irrigation works for the storage, diversion, and development of waters for the reclamation of arid and semiarid lands in the said States and Territories, and for the payment of all other expenditures provided for in this Act: *Provided*, That in case the receipts from the sale and disposal of public lands other than those realized from the sale and disposal of lands referred to in this section are insufficient to meet the requirements for the support of agricultural colleges in the several States and Territories, under the Act of August thirtieth, eighteen hundred and ninety, entitled "An Act to apply a portion of the proceeds of the public lands to the more complete endowment and support of the colleges for the benefit of agriculture and the mechanic arts, established under the provisions of an Act of Congress approved July second, eighteen hundred and sixty-two," the deficiency, if any, in the sum necessary for the support of the said colleges shall be provided for from any moneys in the Treasury not otherwise appropriated.

SEC. 2. That the Secretary of the Interior is hereby authorized and directed to make examinations and surveys for, and to locate and construct, as herein provided, irrigation works for the storage, diversion, and development of waters, including artesian wells, and to report to Congress at the beginning of each regular session as to the results of such examinations and surveys, giving estimates of cost of all contemplated works, the quantity and location of the lands which can be irrigated therefrom, and all facts relative to the practicability of each irrigation project; also the cost of works in process of construction as well as of those which have been completed.

SEC. 3. That the Secretary of the Interior shall, before giving the public notice provided for in section four of this Act, withdraw from public entry the lands required for any irrigation works contemplated under the provisions of this Act, and shall restore to public entry any of the lands so withdrawn when, in his judgment, such lands are not required for the purposes of this Act; and the Secretary of the Interior is hereby authorized, at or immediately prior to the time of beginning the surveys for any contemplated irrigation works, to withdraw from entry, except under the homestead laws, any public lands believed to be susceptible of irrigation from said works: *Provided*, That all lands entered and entries made under the homestead laws within areas so withdrawn during such withdrawal shall be subject to all the provisions, limitations, charges, terms, and conditions of this Act; that said surveys shall be prosecuted diligently to completion, and upon the completion thereof, and of the necessary maps, plans, and estimates of cost, the Secretary of the Interior shall determine whether or not said project is practicable and advisable, and if determined to be impracticable or unadvisable he shall thereupon restore said lands to entry; that public lands which it is proposed to irrigate by means of any contemplated works shall be subject to entry only under the provisions of the homestead laws in tracts of not less than forty nor more than one hundred and sixty acres, and shall be subject to the limitations, charges, terms, and conditions herein provided: *Provided*, That the commutation provisions of the homestead laws shall not apply to entries made under this Act.

SEC. 4. That upon the determination by the Secretary of the Interior that any irrigation project is practicable, he may cause to be let contracts for the construction of the same, in such portions or sections as it may be practicable to construct and complete as parts of the whole project, providing the necessary funds for such portions or sections are available in the reclamation fund, and thereupon he shall give public notice of the lands irrigable under such project, and limit of area per entry, which limit shall represent the acreage which, in the opinion of the Secretary, may be reasonably required for the support of a family upon the lands in question; also of the charges which shall be made per acre upon the said entries, and upon lands in private ownership which may be irrigated by the waters of the said irrigation project, and the number of annual installments, not exceeding ten, in which such charges shall be paid and the time when such payments shall commence. The said charges shall be determined with a view of returning to the reclamation fund the estimated cost of construction of the project, and shall be apportioned equitably: *Provided*, That in all construction work eight hours shall constitute a day's work, and no Mongolian labor shall be employed thereon.

SEC. 5.[1] That the entryman upon lands to be irrigated by such works shall, in addition to compliance with the homestead laws, reclaim at least one-half of the total irrigable area of his entry for agricultural purposes, and before receiving patent for the lands covered by his entry shall pay to the Government the charges apportioned against such tract, as provided in section four. No right to the use of water for land in private ownership shall be sold for a tract exceeding one hundred and sixty acres to any one landowner, and no such sale shall be made to any landowner unless he be an actual bona fide resident on such land, or occupant thereof residing in the neighborhood of said land, and no such right shall permanently attach until all payments therefor are made. The annual installments shall be paid to the receiver of the local land office of the district in which the land is situated, and a failure to make any two payments when due shall render the entry subject to cancellation, with the forfeiture of all rights under this Act, as well as of any moneys already paid thereon. All moneys received from the above sources shall be paid into the reclamation fund. Registers and receivers shall be allowed the usual commissions on all moneys paid for lands entered under this Act.

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[1] Sec. 5. Manner of payments, amended by act of Aug. 9, 1912 (37 Stat., 265).

SEC. 6. That the Secretary of the Interior is hereby authorized and directed to use the reclamation fund for the operation and maintenance of all reservoirs and irrigation works constructed under the provisions of this Act: *Provided*, That when the payments required by this Act are made for the major portion of the lands irrigated from the waters of any of the works herein provided for, then the management and operation of such irrigation works shall pass to the owners of the lands irrigated thereby, to be maintained at their expense under such form of organization and under such rules and regulations as may be acceptable to the Secretary of the Interior: *Provided*, That the title to and the management and operation of the reservoirs and the works necessary for their protection and operation shall remain in the Government until otherwise provided by Congress.

SEC. 7. That where in carrying out the provisions of this Act it becomes necessary to acquire any rights or property, the Secretary of the Interior is hereby authorized to acquire the same for the United States by purchase or by condemnation under judicial process, and to pay from the reclamation fund the sums which may be needed for that purpose, and it shall be the duty of the Attorney-General of the United States upon every application of the Secretary of the Interior, under this Act, to cause proceedings to be commenced for condemnation within thirty days from the receipt of the application at the Department of Justice.

SEC. 8. That nothing in this Act shall be construed as affecting or intended to affect or to in any way interfere with the laws of any State or Territory relating to the control, appropriation, use, or distribution of water used in irrigation, or any vested right acquired thereunder, and the Secretary of the Interior, in carrying out the provisions of this Act, shall proceed in conformity with such laws, and nothing herein shall in any way affect any right of any State or of the Federal Government or of any landowner, appropriator, or user of water in, to, or from any interstate stream or the waters thereof: *Provided*, That the right to the use of water acquired under the provisions of this Act shall be appurtenant to the land irrigated and beneficial use shall be the basis, the measure, and the limit of the right.

SEC. 9.[1] That it is hereby declared to be the duty of the Secretary of the Interior in carrying out the provisions of this Act, so far as the same may be practicable and subject to the existence of feasible irrigation projects, to expend the major portion of the funds arising from the sale of public lands within each State and Territory hereinbefore named for the benefit of arid and semiarid lands within the limits of such State or Territory: *Provided*, That the Secretary may temporarily use such portion of said funds for the benefit of arid or semiarid lands in any particular State or Territory hereinbefore named as he may deem advisable, but when so used the excess shall be restored to the fund as soon as practicable, to the end that ultimately, and in any event, within each ten-year period after the passage of this Act, the expenditures for the benefit of the said States and Territories shall be equalized according to the proportions and subject to the conditions as to practicability and feasibility aforesaid.

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[1] Sec. 9 repealed by act of June 25, 1910 (36 Stat., 835).

SEC. 10. That the Secretary of the Interior is hereby authorized to perform any and all acts and to make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of this Act into full force and effect.

Approved, June 17, 1902 (32 Stat., 388).

RECLAMATION EXTENSION ACT.

An Act Extending the period of payment under reclamation projects, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That any person whose lands hereafter become subject to the terms and conditions of the Act approved June seventeenth, nineteen hundred and two, entitled "An Act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," and Acts amendatory thereof or supplementary thereto, hereafter to be referred to as the reclamation law, and any person who hereafter makes entry thereunder shall at the time of making water-right application or entry, as the case may be, pay into the reclamation fund five per centum of the construction charge fixed for his land as an initial installment, and shall pay the balance of said charge in fifteen annual installments, the first five of which shall each be five per centum of the construction charge and the remainder shall each be seven per centum until the whole amount shall have been paid. The first of the annual installments shall become due and payable on December first of the fifth calendar year after the initial installment: *Provided*, That any water-right applicant or entryman may, if he so elects, pay the whole or any part of the construction charges owing by him within any shorter period: *Provided further*, That entry may be made whenever water is available, as announced by the Secretary of the Interior, and the initial payment be made when the charge per acre is established.

ACT SHALL APPLY TO EXISTING PROJECTS.

SEC. 2. That any person whose land or entry has heretofore become subject to the terms and conditions of the reclamation law shall pay the construction charge, or the portion of the construction charge remaining unpaid, in twenty annual installments, the first of which shall become due and payable on December first of the year in which the public notice affecting his land is issued under this Act, and subsequent installments on December first of each year thereafter. The first four of such installments shall each be two per centum, the next two installments shall each be four per centum, and the next fourteen each six per centum of the total construction charge, or the portion of the construction charge unpaid at the beginning of such installments.

PENALTIES.

SEC. 3. That if any water-right applicant or entryman shall fail to pay any installment of his construction charges when due, there shall be added to the amount unpaid a penalty of one per centum thereof, and there shall be added a like penalty of one per centum of the amount unpaid on the first day of each month thereafter so long as such default shall continue. If any such applicant or entryman shall be one year in default in the payment of any installment of the construction charges and penalties, or any part thereof, his water-right application, and if he be a homestead entryman his entry also, shall be subject to cancellation, and all payments made by him forfeited to the reclamation fund, but no homestead entry shall be subject to contest because of such default: *Provided*, That if the Secretary of the Interior shall so elect, he may cause suit or action to be brought for the recovery of the amount in default and penalties; but if suit or action be brought, the right to declare a cancellation and forfeiture shall be suspended pending such suit or action.

INCREASE OF CHARGES.

SEC. 4. That no increase in the construction charges shall hereafter be made, after the same have been fixed by public notice, except by agreement between the Secretary of the Interior and a majority of the water-right applicants and entrymen to be affected by such increase, whereupon all water-right applicants and entrymen in the area proposed to be affected by the increased charge shall become subject thereto. Such increased charge shall be added to the construction charge and payment thereof distributed over the remaining unpaid installments of construction charges: *Provided*, That the Secretary of the Interior, in his discretion, may agree that such increased construction charge shall be paid in additional annual installments, each of which shall be at least equal to the amount of the largest installment as fixed for the project by the public notice theretofore issued. And such additional installments of the increased construction charge, as so agreed upon, shall become due and payable on December first of each year subsequent to the year when the final installment of the construction charge under such public notice is due and payable: *Provided further*, That all such increased construction charges shall be subject to the same conditions, penalties, and suit or action as provided in section three of this Act.

OPERATION AND MAINTENANCE.

SEC. 5. That in addition to the construction charge, every water right applicant, entryman, or landowner under or upon a reclamation project shall also pay, whenever water service is available for the irrigation of his land, an operation and maintenance charge based upon the total cost of operation and maintenance of the project, or each separate unit thereof, and such charge shall be made for each acre-foot of water delivered; but each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge based upon the charge for delivery of not less than one acre-foot of water: *Provided*, That, whenever any legally organized water users' association or irrigation district shall so request, the Secretary of the Interior is hereby authorized, in his discretion, to transfer to such water users' association or irrigation district the care, operation, and maintenance of all or any part of the project works, subject to such rules and regulations as he may prescribe. If the total amount of operation and maintenance charges and penalties collected for any one irrigation season on any project shall exceed the cost of operation and maintenance of the project during that irrigation season, the balance shall be applied to a reduction of the charge on the project for the next irrigation season, and any deficit incurred may likewise be added to the charge for the next irrigation season.

PENALTIES.

Sec. 6. That all operation and maintenance charges shall become due and payable on the date fixed for each project by the Secretary of the Interior, and if such charge is paid on or before the date when due there shall be a discount of five per centum of such charge; but if such charge is unpaid on the first day of the third calendar month thereafter, a penalty of one per centum of the amount unpaid shall be added thereto, and thereafter an additional penalty of one per centum of the amount unpaid shall be added on the first day of each calendar month if such charge and penalties shall remain unpaid, and no water shall be delivered to the lands of any water-right applicant or entryman who shall be in arrears for more than one calendar year for the payment of any charge for operation and maintenance, or any annual construction charge and penalties. If any water-right applicant or entryman shall be one year in arrears in the payment of any charge for operation and maintenance and penalties, or any part thereof, his water-right application, and if he be a homestead entryman his entry also, shall be subject to cancellation, and all payments made by him forfeited to the reclamation fund, but no homestead entry shall be subject to contest because of such arrears. In the discretion of the Secretary of the Interior suit or action may be brought for the amounts in default and penalties in like manner as provided in section three of this Act.

FISCAL AGENT.

Sec. 7. That the Secretary of the Interior is hereby authorized, in his discretion, to designate and appoint, under such rules and regulations as he may prescribe, the legally organized water users' association or irrigation district, under any reclamation project, as the fiscal agent of the United States to collect the annual payments on the construction charge of the project and the annual charges for operation and maintenance and all penalties: *Provided*, That no water-right applicant or entryman shall be entitled to credit for any payment thus made until the same shall have been paid over to an officer designated by the Secretary of the Interior to receive the same.

RECLAMATION REQUIREMENTS.

SEC. 8. That the Secretary of the Interior is hereby authorized to make general rules and regulations governing the use of water in the irrigation of the lands within any project, and may require the reclamation for agricultural purposes and the cultivation of one-fourth the irrigable area under each water-right application or entry within three full irrigation seasons after the filing of water-right application or entry, and the reclamation for agricultural purposes and the cultivation of one-half the irrigable area within five full irrigation seasons after the filing of the water-right application or entry, and shall provide for continued compliance with such requirements. Failure on the part of any water-right applicant or entryman to comply with such requirements shall render his application or entry subject to cancellation.

LANDS NOT SUBJECT TO RECLAMATION ACT.

SEC. 9. That in all cases where application for water right for lands in private ownership or lands held under entries not subject to the reclamation law shall not be made within one year after the passage of this Act, or within one year after notice issued in pursuance of section four of the reclamation Act, in cases where such notice has not heretofore been issued, the construction charges for such land shall be increased five per centum each year until such application is made and an initial installment is paid.

WITHDRAWN LANDS SUBJECT TO ENTRY.

SEC. 10. That the Act of Congress approved February eighteenth, nineteen hundred and eleven, entitled "An Act to amend section five of the Act of Congress of June twenty-fifth, nineteen hundred and ten, entitled 'An Act to authorize advances to the reclamation fund and for the issuance and disposal of certificates of indebtedness in reimbursement therefor, and for other purposes,'" be, and the same hereby is, amended so as to read as follows:

"SEC. 5. That no entry shall be hereafter made and no entryman shall be permitted to go upon lands reserved for irrigation purposes until the Secretary of the Interior shall have established the unit of acreage per entry, and water is ready to be delivered for the land in such unit or some part thereof and such fact has been announced by the Secretary of the Interior: *Provided*, That where entries made prior to June twenty-fifth, nineteen hundred and ten, have been or may be relinquished, in whole or in part, the lands so relinquished shall be subject to settlement and entry under the reclamation law."

WATER SERVICE.

SEC. 11. That whenever water is available and it is impracticable to apportion operation and maintenance charges as provided in section five of this Act, the Secretary of the Interior may, prior to giving public notice of the construction charge per acre upon land under any project, furnish water to any entryman or private landowner thereunder until such notice is given, making a reasonable charge therefor, and such charges shall be subject to the same penalties and to the provisions for cancellation and collection as herein provided for other operation and maintenance charges.

ADMISSION OF PRIVATE LANDOWNERS TO NEW PROJECTS.

Sec. 12. That before any contract is let or work begun for the construction of any reclamation project hereafter adopted the Secretary of the Interior shall require the owners of private lands thereunder to agree to dispose of all lands in excess of the area which he shall deem sufficient for the support of a family upon the land in question, upon such terms and at not to exceed such price as the Secretary of the Interior may designate; and if any landowner shall refuse to agree to the requirements fixed by the Secretary of the Interior, his land shall not be included within the project if adopted for construction.

DISPOSITION OF EXCESS FARM UNITS.

Sec. 13. That all entries under reclamation projects containing more than one farm unit shall be reduced in area and conformed to a single farm unit within two years after making proof of residence, improvement, and cultivation, or within two years after the issuance of a farm-unit plat for the project, if the same issues subsequent to the making of such proof: *Provided*, That such proof is made within four years from the date as announced by the Secretary of the Interior that water is available for delivery for the land. Any entryman failing within the period herein provided to dispose of the excess of his entry above one farm unit, in the manner provided by law, and to conform his entry to a single farm unit shall render his entry subject to cancellation as to the excess above one farm unit: *Provided*, That upon compliance with the provisions of law such entryman shall be entitled to receive a patent for that part of his entry which conforms to one farm unit as established for the project: *Provided further*, That no person shall hold by assignment more than one farm unit prior to final payment of all charges for all the land held by him subject to the reclamation law, except operation and maintenance charges not then due.

ACCEPTANCE OF THIS ACT.

Sec. 14. That any person whose land or entry has heretofore become subject to the reclamation law, who desires to secure the benefits of the extension of the period of payments provided by this Act, shall, within six months after the issuance of the first public notice hereunder affecting his land or entry, notify the Secretary of the Interior, in the manner to be prescribed by said Secretary, of his acceptance of all of the terms and conditions of this Act, and thereafter his lands or entry shall be subject to all of the provisions of this Act.

SEC. 15. That the Secretary of the Interior is hereby authorized to perform any and all acts and to make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of this Act into full force and effect.

SEC. 16. That from and after July first, nineteen hundred and fifteen, expenditures shall not be made for carrying out the purposes of the reclamation law except out of appropriations made annually by Congress therefor, and the Secretary of the Interior shall, for the fiscal year nineteen hundred and sixteen, and annually thereafter, in the regular Book of Estimates, submit to Congress estimates of the amount of money necessary to be expended for carrying out any or all of the purposes authorized by the reclamation law, including the extension and completion of existing projects and units thereof and the construction of new projects. The annual appropriations made hereunder by Congress for such purposes shall be paid out of the reclamation fund provided for by the reclamation law.

Approved, August 13, 1914 (38 Stat., 686).

APPROPRIATION FOR UNITED STATES RECLAMATION SERVICE, FISCAL YEAR 1917.

The following is the appropriation for the Reclamation Service for the fiscal year 1917, beginning July 1, 1916, and ending June 30, 1917, as found in the sundry civil appropriation act approved July 1, 1916, Public, No. 132:

RECLAMATION SERVICE.

The following sums are appropriated out of the special fund in the Treasury of the United States created by the Act of June seventeenth, nineteen hundred and two (Thirty-second Statutes, page three hundred and eighty-eight), and therein designated "the reclamation fund":

For all expenditures authorized by the Act of June seventeenth, nineteen hundred and two (Thirty-second Statutes, page three hundred and eighty-eight), and Acts amendatory thereof and supplementary thereto, known as the reclamation law, and all other Acts under which expenditures from said fund are authorized, including salaries in the city of Washington and elsewhere; rent of office quarters in the city of Washington, $8,400, and for rent elsewhere; examination of estimates for appropriations in the field; printing and binding; law books, books of reference, periodicals, engineering and statistical publications, not exceeding $1,500; purchase, maintenance, and operation of horse-drawn or motor-propelled passenger-carrying vehicles; per diem in lieu of subsistence, when allowed, pursuant to section thirteen of the sundry civil appropriation Act approved August first, nineteen hundred and fourteen; payment of damages caused to the owners of lands or private property of any kind by reason of the operations of the United States, its officers or employees, in the survey, construction, operation, or maintenance of irrigation works, and which may be compromised by agreement between the claimant and the Secretary of the Interior; and compensation to artisans and laborers for injuries under the Act of May thirtieth, nineteen hundred and eight (Thirty-fifth Statutes, page five hundred and fifty-six), namely:

Salt River project, Arizona: For maintenance, operation, continuation of construction, and incidental operations, $480,000 together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen: *Provided*, That there is hereby appropriated, out of said sum, the sum of $300 to reimburse the Moeur-Pafford Company, a corporation organized under the laws of Arizona, for damages sustained by the reason of the inability, under existing law, of the United States to carry out a certain agreement between said company and the project manager in connection with a contract dated November twenty-fifth, nineteen hundred and eleven, between said company and the project manager of the Reclamation Service, Salt River project, Arizona, approved by the Director of the Reclamation Service on December twentieth, nineteen hundred and eleven;

Yuma project, Arizona-California: For maintenance, operation, continuation of construction, and incidental operation, $759,000; together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen;

Orland project, California: For maintenance, operation, continuation of construction, and incidental operations, $33,000, together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen;

Grand Valley project, Colorado: For maintenance, operation, continuation of construction, and incidental operations, $309,000; together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen;

Uncompahgre project, Colorado: For maintenance, operation, continuation of construction, and incidental operations, $288,000;

Boise project, Idaho: For maintenance, operation, continuation of construction, and incidental operations, $540,000 together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen;

Minidoka project, Idaho: For maintenance, operation, continuation of construction, and incidental operations, $302,000;

Jackson Lake enlargement work, Idaho-Wyoming: For maintenance, operation, continuation of construction, and incidental operations, conditioned upon the deposit of this amount by the Kuhn Irrigation and Canal Company and the Twin Falls Canal Company to the credit of the reclamation fund, $241,000;

Garden City project, Kansas: For maintenance, operation, and incidental operations, $2,000;

Huntley project, Montana: For maintenance, operation, continuation of construction, and incidental operations, $160,000;

Milk River project, Montana: For maintenance, operation, continuation of construction, and incidental operations, $696,000;

Sun River project, Montana: For maintenance, operation, continuation of construction, and incidental operations, $205,000;

Lower Yellowstone project, Montana-North Dakota: For maintenance, operation, continuation of construction, and incidental operations, $30,000;

North Platte project, Nebraska-Wyoming: For maintenance, operation, continuation of construction, and incidental operations, $1,100,000, together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen;

Truckee-Carson project, Nevada: For maintenance, operation, continuation of construction, and incidental operations, $220,000, together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen;

Carlsbad project, New Mexico: For maintenance, operation, continuation of construction, and incidental operations, $323,000 together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen;

Hondo project, New Mexico: For maintenance, operation, and incidental operations, $4,000;

Rio Grande project, New Mexico-Texas: For maintenance, operation, continuation of construction, and incidental operations, $595,000, together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen;

North Dakota pumping project, North Dakota: For maintenance, operation, continuation of construction, and incidental operations, $50,000;

Lawton project, Oklahoma: For maintenance, operation, continuation of construction, and incidental operations, $51,000;

Umatilla project, Oregon: For maintenance, operation, continuation of construction, and incidental operations, $235,000;

Klamath project, Oregon-California: For maintenance, operation, continuation of construction, and incidental operations, $180,000; together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen;

Belle Fourche project, South Dakota: For maintenance, operation, continuation of construction, and incidental operations, $98,000, together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen;

Strawberry Valley project, Utah: For maintenance, operation, continuation of construction, and incidental operations, $315,000;

Okanogan project, Washington: For maintenance, operation, continuation of construction, and incidental operations, $58,000;

Yakima project, Washington: For maintenance, operation, continuation of construction, and incidental operations, $798,000, together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen;

Shoshone project, Wyoming: For maintenance, operation, continuation of construction, and incidental operations, $762,000 together with the unexpended balance of the sum appropriated for this project for the fiscal year nineteen hundred and sixteen;

For cooperative and other miscellaneous investigations (secondary projects), $50,000;

Under the provisions of this Act no greater sum shall be expended, nor shall the United States be obligated to expend, during the fiscal year nineteen hundred and seventeen, on any reclamation project appropriated for herein an amount in excess of the sum herein appropriated therefor, nor shall the whole expenditures or obligations incurred for all of such projects for the fiscal year nineteen hundred and seventeen exceed the whole amount in the "reclamation fund" for that fiscal year;

Ten per centum of the foregoing amounts shall be available interchangeably for expenditure on the reclamation projects named; but not more than ten per centum shall be added to the amount appropriated for any one of said projects;

All moneys refunded except repayments of construction and operation and maintenance charges, under the provisions of the Act shall be a credit to the appropriation for the project from or on account of which the collection is made and shall be available for expenditure in like manner as if said sum had been specifically appropriated for said project in this Act;

In all, for the Reclamation Service, $8,884,000.

VALIDATION OF ENTRIES.

[PUBLIC—No. 72.]

An Act To amend the Act of June twenty-third, nineteen hundred and ten, entitled "An Act providing that entrymen for homesteads within the reclamation projects may assign their entries upon satisfactory proof of residence, improvement, and cultivation for five years, the same as though said entry had been made under the original homestead Act."

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act of June twenty-third, nineteen hundred and ten (Public, Two hundred and forty-three, Thirty-sixth Statutes, page five hundred and ninety-two), entitled "An Act providing that entrymen for homesteads within reclamation projects may assign their entries upon satisfactory proof of residence, improvement, and cultivation for five years, the same as though said entry had been made under the original homestead Act," is hereby amended by adding the following proviso:

"*Provided*, That in the absence of any intervening valid adverse interests any assignment made between June twenty-third, nineteen hundred and ten, and January first, nineteen hundred and thirteen, of land upon which the assignor has submitted satisfactory final proof and the assignee purchased with the belief that the assignment was valid and under the Act of June twenty-third, nineteen hundred and ten, is hereby confirmed, and the assignee shall be entitled to the land assigned as under the Act of June twenty-third, nineteen hundred and ten, notwithstanding that said original entry was conformed to farm units and that the part assigned was canceled and eliminated from said entry prior to the date of final proof: *Provided further*, That all entries so assigned shall be subject to the limitations, terms, and conditions of the reclamation Act and Acts amendatory thereof or supplemental thereto, and all of said assignees whose entries are hereby confirmed shall, as a condition to receiving patent, make the proof heretofore required of assignees."

Approved, May 8, 1916.

ACCEPTANCE OF PROVISIONS OF EXTENSION ACT.

[PUBLIC—No. 167.]

An Act To amend section fourteen of the reclamation extension Act approved August thirteenth, nineteen hundred and fourteen.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section fourteen of an Act entitled "An Act extending the period of payment under reclamation projects, and for other purposes," approved August thirteenth, nineteen hundred and fourteen, be amended so as to read as follows:

"SEC. 14. That any person whose land or entry has heretofore become subject to the reclamation law, who desires to secure the benefits of the extension of the period of payments provided by this Act, shall, within six months after the issuance of the first public notice hereunder affecting his land or entry, notify the Secretary of the interior, in the manner to be prescribed by said Secretary, of his acceptance of all the terms and conditions of this Act, and thereafter his lands or entry shall be subject to all of the provisions of this Act: *Provided*, That upon sufficient showing the Secretary of the Interior may, in his discretion, permit notice of acceptance of all the terms and conditions of this Act to be filed at any time after the time limit hereinbefore fixed for filing such acceptance shall have expired, conditioned, however, that where the applicant for such acceptance is in arrears on construction charges, he shall at the time of acceptance pay such installments of the construction charge as he would have been required to pay had he accepted this Act within the time limit hereinabove fixed, plus the penalties that would have accrued had he so accepted, and such applicant shall thereafter be upon the same status that he would have been had he accepted the provisions of this Act within the time limit hereinabove fixed, and thereafter the lands or entry of any such persons so filing such notice of acceptance shall be subject to all the provisions of this Act."

Approved, July 26, 1916.

DECISIONS OF THE COURTS CONSTRUING THE RECLAMATION LAW.

(IN THE SUPREME COURT OF THE UNITED STATES).

SECRETARY HAS AUTHORITY TO ASSESS OPERATION AND MAINTENANCE COSTS OF PROJECT DURING THE GOVERNMENT-HELD PERIOD.

The statutory provision for charging the cost of construction of an improvement against property benefited may include the cost of maintenance, as well as the actual construction; and in determining the scope of the provision the court may arrive at the legislative intent by examining the history of the statute.

The history of the reclamation act of 1902 shows it was the intent of Congress that the cost of each irrigation district should be assessed against the property benefited, and that the assessments as fast as collected should be paid back into the fund for use in subsequent projects without diminution. This intent can not be carried out without charging the expense of maintenance during the Government-held period as well as the cost of construction.

Subsequent legislative construction of a prior act may properly be examined as an aid to its interpretation: and so *held* that statutes passed since the reclamation act of 1902 indicated that Congress has construed the provisions of that act as authorizing the Secretary of the Interior to assess cost of maintenance as well as of construction of irrigation projects upon the land benefited.

Where the executive officer charged with its enforcement sent reports to Congress on some construction of a statute, it is significant if Congress never has taken any adverse action in regard to such construction.

Quaere: Whether Congress may not by legislation construe a prior statute so that as to all matters subsequently arising action is legislative in character.

The repeated and practical construction of the reclamation act of 1902 by both Congress and the Secretary of the Interior in charging the cost of maintenance as well as construction accords with the provisions of the act taken in its entirety and is followed by the court. (Swigart *v.* Baker (Washington), 229 U. S., 187; 199 Fed., 865, reversed; 196 Fed., 569, affirmed.)

RAILROAD COMPANY MAY SECURE RIGHT OF WAY ACROSS RECLAMATION PROJECT.

Under the policy of the Government to encourage the building of railroads in the Western States, Congress has in some cases granted land to aid in construction, and has also provided the means by which those companies not having such grants can, under reasonable conditions, acquire rights of way over public lands.

While the right of way statute only applies to public lands, and therefore does not apply to lands segregated from the public domain by homestead entries, settlers may, under section 2288, Revised Statutes, grant rights of way over land before final proof.

Nothing in the reclamation act affects the provision of section 2288, Revised Statutes, permitting a homesteader without patent, but in lawful possession, to grant to a railroad company a right of way across his claim.

Privileges for granting to railroad companies rights of way over homesteaders' land under entry were renewed and extended by the act of March 3, 1905, Chap. 1424, 33 Stat., 991.

The various acts of Congress in effect operate to give the consent of the United States to the construction of a railroad as an instrumentality of commerce across the lands of those homesteaders within the limits of the Minidoka Irrigation project in Idaho who gave deeds for the right of way to the railroad company. (Minidoka & Southwestern Railroad Co. *v.* United States (Idaho), 235 U. S., 211; 190 Fed., 491, reversed; 176 Fed., 762, affirmed.)

UNITED STATES MAY ACQUIRE INDIAN ALLOTMENT FOR RECLAMATION PURPOSES.

Under the provisions of the reclamation act, the Secretary of the Interior has power to acquire the rights and property necessary therefor, including those of allottee Indians by paying for their improvements, and giving them the right of selecting other lands.

The restrictions on alienation of lands allotted to Indians within the area of the Milk River irrigation project do not extend to prohibiting an allottee Indian from selling his improvements to the United States, and selecting other lands so that the United States could use the lands selected for purposes of an irrigation project as provided by act of Congress. (Henkel *v.* U. S. (Montana), 237 U. S., 43; 196 Fed., 345, affirmed.)

(IN THE CIRCUIT COURT OF APPEALS.)

CONSTITUTIONALITY OF RECLAMATION ACT—WITHDRAWAL OF PUBLIC LANDS FOR PURPOSES OF ACT—RIGHTS OF SETTLER UPON UNSURVEYED PUBLIC LAND.

The reclamation act is within the power of Congress as to lands within the States as well as Territories, under the Constitution, article 4, section 3, giving it power "to dispose of and make all needful rules and regulations respecting the territory or other property belonging to the United States," and is not in violation of the Constitution on the ground that it authorizes the expenditure of public money without an appropriation, since it is in itself an appropriation of the proceeds of land sold, nor as delegating legislative authority to the Secretary of the Interior.

The reclamation act directs the Secretary of the Interior to "withdraw from public entry the lands required for any irrigation works contemplated under the provisions of this act," and authorizes him "to withdraw from entry, except under the homestead laws. any public lands believed to be susceptible of irrigation from said works." Held that two classes of withdrawals were thereby provided for, and that the exception of homestead entry from the second had no application to the first; withdrawals and reservations thereunder being, from the necessity of the case, absolute.

The reclamation act contains no provision for the recognition or protection of any right of a settler of unsurveyed public lands which may be withdrawn and reserved thereunder for use in the construction of irrigation works, and such settler has no right which he can oppose to the taking of the land for such purposes. (United States *v.* Hanson (Washington), 167 Fed., 881, reversing trial court.)

PRIVATE LANDS IN RECLAMATION PROJECTS—CONSTITUTIONAL AUTHORITY OF THE UNITED STATES—EMINENT DOMAIN.

The reclamation act contemplated the irrigation of private lands as well as lands belonging to the Government, and the fact that the scheme contemplates the irrigation of private as well as a large tract of Government land does not render a project illegal, so as to prevent the condemnation of land necessary to carry it out.

The United States has constitutional authority to organize and maintain an irrigation project within a State where it owns arid lands, whereby it will associate with itself other owners of like lands for the purpose of reclaiming and improving them, and for that purpose it exercises the right of eminent domain against other landowners to obtain land necessary to carry the proposed project in effect. (Burley *v.* United States et al. (Idaho), 179 Fed., 1; affirming 172 Fed., 615.)

WATER USERS' ASSOCIATION PROPER PARTY PLAINTIFF IN SUIT TO ENJOIN UNITED STATES OFFICERS FROM COLLECTING UNLAWFUL WATER CHARGES FROM SHAREHOLDERS.

A corporation with which, as the representative of its shareholders, who are parties accepted by the United States as holders of water rights in a project under the reclamation act, the United States makes a contract for the benefit of such shareholders relative to the supply of water due and the dues to be paid by the shareholders and which covenants in the contract to collect dues for the United States and guarantees the payment thereof, is the proper party plaintiff in a suit to enjoin officers of the United States from collecting unlawful charges from the shareholders, turning the water from their lands, and canceling their water rights and homestead rights because they fail to pay such charges. (Magruder et al. *v.* Belle Fourche Valley Water Users' Association (South Dakota), 219 Fed., 72, affirming lower court.)

(IN FEDERAL TRIAL COURTS.)

RESERVATION IN PUBLIC LAND PATENT OF RIGHT OF WAY FOR IRRIGATION CANALS REFERS TO FUTURE CONSTRUCTION.

The act of Congress August 30, 1890 (26 Stat., 391), provides that all patents for land thereafter taken up under any of the land laws of the United States on entries or claims validated by the act west of the one hundredth meridian should reserve a right of way for ditches or canals "constructed" by authority of the United States. *Held*, that the word "constructed" as so used did not limit the reservation to a right of way for ditches already constructed, but extended as well to those "to be constructed" by the Government in furtherance of its irrigation scheme for the reformation of arid lands. (Green *v.* Willhite et al. (Idaho), 160 Fed., 855. See Green *v.* Willhite et al., 93 Pac., 971.)

RIGHT OF SECRETARY TO IMPOSE ASSESSMENT BEFORE PROJECT PASSES UNDER MANAGEMENT OF LANDOWNERS—LIABILITY OF LANDOWNERS.

The Secretary of the Interior, being authorized to tax and determine irrigation-project charges, is authorized to divide the same into two parts, one for construction and the other for operation and maintenance, and hence he is authorized to impose reasonable assessments on land irrigated prior to the time when payment of the major portion of the cost of construction has been made and the works pass under management of the owners of irrigated land.

Where by a contract between the United States and landowners tributary to a Federal irrigation system such landowners agree to pay to the United States the charges duly levied against their lands for the construction and maintenance of the system, they are only liable for such reasonable charges as the Government is authorized to collect, proportionate to their share of the cost of operating and maintaining the system, and not such as might be arbitrarily fixed in advance by such Secretary or other Governmental officer. (United States *v.* Cantrall et al. (Oregon), 176 Fed., 949.)

CONSTRUCTION OF RECLAMATION PROJECTS NOT A GOVERNMENTAL FUNCTION—RECLAMATION ACT NOT A REVENUE LAW—REMOVAL OF CAUSES.

In the construction of works for the irrigation of arid public lands under the reclamation act the United States is not exercising a governmental function nor even a strictly public function, but is promoting its proprietary interests, and such advantage as arises therefrom to the public at large is material, and not governmental.

The act is not a "revenue law" within the meaning of Revised Statutes, section 643 (United States Compiled Statutes of 1901, p. 521), which provides for the removal of suits brought in State courts "against any officer appointed under or acting by authority of any revenue law of the United States." On account of any act done under color of his office, a suit against the officer in charge of reclamation work to determine water rights in a stream is not removable by him thereunder. Nor is there any reason of public policy why such suit should be transferred to the Federal courts, as by the terms of the act the rights of the Government as an appropriator of water are governed by the laws of the State and are no greater than those of any other officer. (Twin Falls Canal Co., Ltd., *v.* Foote et al., (Idaho), 192 Fed., 583. Followed in City of Stanfield *v.* Umatilla River Water Users' Association et al. (Oregon), 192 Fed., 596.)

ACT PROVIDING RESERVATION IN PUBLIC-LAND PATENT OF RIGHT OF WAY FOR IRRIGATION CANALS NOT VOID FOR INDEFINITENESS—EQUITY JURISDICTION.

The provisions of act of August 30, 1890 (26 Stat., 391), that in all patents for lands thereafter taken up under any of the land laws west of the one hundredth meridian, it shall be expressed that there is reserved from the lands a right of way thereon for ditches or canals constructed by the authority of the United States, must be construed in the light of the known purpose of the Government to reclaim its arid lands by conducting water upon them, and the provision is not void for indefiniteness because the right of way reserved is not specifically described but is within the undoubted powers of Congress and valid, and all subsequent entrymen took their lands subject to the right of the United States to construct ditches and canals over it whenever and wherever required in carrying out any of its reclamation projects.

Equity has jurisdiction of a suit by the United States against the owners of lands acquired under the public land laws after the passage of this act to enjoin them from interfering with its construction of an irrigation canal over such lands under the reservation of right of way therefor contained in said act. (United States *v.* Van Horn et al., (Colorado), 197 Fed., 611.)

CONDEMNATION UNDER RECLAMATION ACT NOT SUBJECT TO LIMITATION BY STATE STATUTES, NOR GOVERNED BY STATE PROCEDURE—POSSESSION GIVEN PRIOR TO PAYMENT.

The power conferred on the Secretary of the Interior by the reclamation act to condemn lands necessary for use in constructing irrigation works is not subject to limitation by State Statutes relating to the exercise of the power of eminent domain of the State, nor is its exercise governed by a State procedure requiring the necessity of the taking in each particular case to be determined by a local commission, but such necessity is a matter to be determined by the Secretary, whose decision is not reviewable by the courts.

Lands condemned by the United States under the reclamation act for right of way for a canal or ditch required in the carrying out of an irrigation project, are taken for a public use.

In proceedings by the United States to condemn right of way for a ditch under the reclamation act which provides a fund from which the damages assessed shall be paid, it is not necessary that the damages shall be assessed and paid before the Government may be allowed to take possession. (United States *v.* O'Neill et al. (Colorado) 198 Fed. 677.)

RIGHT OF STATE TO TAX LAND WITHIN RECLAMATION PROJECT OF THE UNITED STATES.

A patent to lands within a reclamation project issued to a homestead entryman under act of August 9, 1912 (37 Stat. 265) on proof of compliance with the provisions of law as to residence, reclamation, and irrigation conveys a legal title, the Government reserving only a prior lien on the land and appurtenant water rights as security for the payment of all sums due or to become due on such water rights, and such lands are taxable by the State; the lien of the tax, however, being subject to the prior lien reserved by the Government. Homestead entrymen on such lands who have made proof of compliance with the general homestead laws, but have not fully complied with the additional requirements of the reclamation act as to reclamation and irrigation, have a vested interest which may be sold, mortgaged, and inherited and which also is subject to local taxation.

Generally speaking, one who has the right to real property and is not excluded from its use and enjoyment should not be permitted to use the legal title of the Government to avoid his just share of taxation. (United States *v.* Canyon County, Idaho, et al. 232 Fed. 985. Citing Cheney *v.* Minidoka County, 144 Pac. 343.)

IN STATE COURTS.

RESERVATION IN PUBLIC-LAND PATENT OF RIGHT OF WAY FOR IRRIGATION CANALS REFERS TO FUTURE CONSTRUCTION.

Under the provisions of sundry civil appropriation act, August 30, 1890, chapter 837, 26 Statutes 391 (United States Compiled Statutes 1901, p. 1570), which provides "that in all patents for lands hereafter taken up under any of the land laws of the United States, or on entries or claims validated by this act, west of the one hundredth meridian, it shall be expressed that there is reserved from the land in said patent described a right of way thereon for ditches or canals constructed by authority of the United States," the word "constructed" as there used, has a general reference and application to ditches or canals constructed by authority of the United States, without reference to the time of such construction.

Under the provisions of the act above quoted it was the evident intention of Congress to reserve perpetually to the Government an easement and right of way through and over any and all lands west of the one hundredth meridian that the Government might grant to settlers and purchasers subsequent to the passage of the act, and to thereby reserve the easement and right of way for the construction, maintenance, and operation of any ditches and canals the Government may construct at any time in the future for the irrigation and reclamation of arid lands. (Green *v.* Wilhite et al. (Idaho) 93 Pac. 971.)

FIRST FORM WITHDRAWALS NOT SUBJECT TO MINING LOCATION; SECOND FORM WITHDRAWALS SO SUBJECT.

Under the reclamation act directing the Secretary of the Interior (1) to withdraw from entry the lands for any irrigation works contemplated by the act, and (2) authorizing him to withdraw any lands believed to be susceptible of irrigation from such works, withdrawals under the first class are not subject to location for mining purposes, being reserved for Government use, while lands withdrawn under the second class are disposed of only for homesteads, and as all lands open to homestead entry are subject to mining location, lands withdrawn under the second class are so subject. (Loney et al. *v.* Scott (Oregon) 112 Pac. 172.)

SECRETARY HAS POWER TO CONTRACT WITH IRRIGATION DISTRICT TO SUPPLY WATER AND DRAIN LAND.

Under the provisions of the reclamation act, June 17, 1902, and the Warren Act, February 21, 1911, the Secretary of the Interior is authorized and has the power to contract with an irrigation district for supplying water to such district, or partially supplying it with water, for the irrigation of the lands therein and for the drainage of other lands within such district. (Pioneer Irrigation District *v.* Stone (Idaho) 130 Pac. 382. Followed in Hillcrest Irrigation District *v.* Brose (Idaho) 133 Pac. 663, and Nampa and Meridian Irrigation District *v.* Petrie et al. (Idaho) 153 Pac. 425.)

STATE TAXATION OF LAND WITHIN RECLAMATION PROJECT—INTERESTS OF THE UNITED STATES.

Where a homestead entryman of land included within a Government reclamation project presents proof to the proper Government officer that he has complied with the law in relation to residence and cultivation of said land, and secures a certificate from the United States that his proof has been accepted, further residence on the land is not required in order to obtain final certificate and patent, and patent will issue upon proof that at least one-half of the irrigable area in the entry as finally adjusted has been reclaimed and that all the charges and fees and commissions due on account thereof have been paid to the proper officer of the Government.

Where such entryman, in addition to establishing his residence on and cultivation of such land, has paid the United States five annual installments on his water right, amounting to $11 per acre, as provided by the reclamation act and the rulings of the Secretary of the Interior thereunder, and the entryman still owes the United States five annual installments in payment of what is known as the construction charge for the irrigation canals and other works constructed by the United States for the purpose of furnishing water to the land entered, he has an equitable interest in such land, which is "property" within the meaning of that word as used in the constitution and laws of this State, and the matter then rests wholly with the entryman whether he will make the deferred payments and the additional proof required by said reclamation act.

Under said act, where a person has so far complied with the provisions of said law as to residence and cultivation of land for more than five years, he can complete his title at any time by making final proof and paying the deferred payments on his water right and the fees provided by law to be paid. Under said act the Government simply retains title as security for payment of the money owing on the purchase price of the water right for such land.

When such entryman makes his proof of residence and cultivation, and there only remains the lien of the Government for deferred payments on the water right for such land, the entryman's interest in such land is taxable.

The interests of the entryman in such land can be sold at delinquent tax sale and the lien of such sale foreclosed and title thereto obtained.

Nothing that the taxing authorities have done or could do can or will affect the lien rights or interests of the United States in such land for the deferred payments on the water right.—(Cheney *v.* Minidoka County et al. (Idaho) 144 Pac., 343.)

LITIGATION.

[Cases initiated in the fiscal year ending June 30, 1916, marked thus: *.]

ARIZONA, SALT RIVER PROJECT.

Arizona Alfalfa Milling Company v. *United States.*—Suit brought June 2, 1913, in Court of Claims for $46,527.36. Case pending.

State v. *A. J. Haltom.*—Warrant for criminal trespass, issued May 10, 1915, from court of justice of the peace at Phoenix. Case pending on appeal taken to Superior Court for Maricopa County.

W. B. Lount and Hattie L. Mosher v. *A. J. Haltom.*—Suit brought May 25, 1915, in Superior Court for Maricopa County for $1,718.96 damages. Tried April 12–13–14, 1916, and verdict rendered for defendant. Case pending on plaintiffs' motion for a new trial.

**United States* v. *Alice M. Mitchell et al.*—Proceedings initiated October 27, 1915, in United States district court for condemnation of land for canal right of way. Case pending.

ARIZONA-CALIFORNIA, YUMA PROJECT.

No litigation.

CALIFORNIA, ORLAND PROJECT.

No litigation.

COLORADO, GRAND VALLEY PROJECT.

In re Adjudication Water Rights, Grand River, District No. 42.—Petition filed November 2, 1908, in State district court. October 4, 1915, Colorado Supreme Court quashed writ of error without prejudice to United States, on ground that judgment was not final. Orchard Mesa Irrigation District intervened to have its rights determined. Decree entered November 5, 1915. On November 6, 1915, motion of United States for new trial denied, written exceptions filed and leave granted for extension of the record.

COLORADO, UNCOMPAHGRE VALLEY PROJECT.

United States to the use of the Montrose Hardware Company et al. v. *C. D. McPhee et al.*—Suit brought September 11, 1905, in State district court. Appeal argued in Supreme Court of Colorado January 17, 1916; decision not yet rendered.

United States v. *Alymer F. Reeves.*—Condemnation proceedings brought March 17, 1911, in United States district court for canal right of way. Case pending.

United States v. *Martin Van Horn et al.*—Suit brought April 25, 1912, in United States district court for an injunction. Case pending.

IDAHO, BOISE PROJECT.

Farmers Cooperative Ditch Co. v. *Riverside Irrigation District et al.*—Suit brought in August, 1902, in State district court, to adjudicate water rights. Notice given of application for a temporary order of court for the season of 1916 providing a sliding scale allowing varying amounts of water during various portions of the season.

United States v. *Highland Valley Power Co.*—Suit brought February 2, 1911, in Federal court, to quiet title. The United States has taken title through purchase at receiver's sale (July 31, 1916) and the case has been dismissed.

Page & Brinton v. *United States.*—Petition filed February 27, 1912, in Court of Claims for $325,000 damages. Testimony was taken during July and August, 1915, at Boise, Idaho, and Salt Lake City, Utah. It is expected the case will be argued before the Court of Claims some time during the coming winter.

United States v. *Marsters and Lakin.*—Suit brought July 13, 1913, in United States District Court, for injunction and damages. Defendants' appeal to Circuit Court of Appeals argued February 23, 1916, but not yet decided.

Pioneer Irrigation District v. *American Ditch Co. et al.*—Suit brought July 14, 1913, in State district court for adjudication of water rights. Tried at Caldwell, Idaho, November 11–12, 1915. Argued and submitted November 24, 1915, but not yet decided.

United States v. *American Ditch Co., et al.*—Suit brought October 3, 1913, in United States district court to adjudicate water rights. Case pending.

George R. Glover v. *Frank L. Brown, United States, et al.*—Suit brought in February, 1914, to quiet title. Case dismissed as to United States in August, 1915.

United States v. *State of Idaho.*—Complaint filed August 26, 1914, for condemnation of land. Case pending.

United States v. *State of Idaho.*—Complaint filed August 26, 1914, for condemnation of land. Case pending.

In re petition of Nampa and Meridian Irrigation District for confirmation of proposed contract with the United States and proceed-

ings in connection therewith—Nampa and Meridian Irrigation District v. *Petrie et al.*—Case brought February 8, 1915, in State district court, to confirm contract. Objecting parties appealed to the Supreme Court, October 29, 1915, and the case was argued in that court November 20, 1915. Judgment of trial court affirmed. (See 153 Pac., 425.)

* *United States* v. *Boise Fruit Tracts Co. et al.*—Suit brought August 20, 1915, for an injunction to restrain defendants from transferring or changing point of diversion of certain old water rights on Boise River. In June, 1916, case settled by stipulation to the effect that permanent injunction issue as prayed for, except as to one right.

* *United States* v. *Canyon County et al.*—Suit brought in December, 1915, in the United States district court to determine right of the county to tax two certain classes of reclamation homestead lands before complete title has passed from the United States to the entryman. The two classes referred to are: (a) Those where the entryman has not yet secured patent or final certificate or made reclamation proof, but has made residence proof and received certificate of compliance with the provisions of the ordinary homestead law; and (b) those for which the conditional reclamation patent has been issued reserving a lien in favor of the United States. April 29, 1916, the trial court rendered a decision holding both classes of lands taxable.

* *United States* v. *Samuel W. Shook et al.*—Proceedings brought March 28, 1916, to condemn a strip of land needed as right of way for the Ten Mile Drainage Canal of the Boise project. Issue has been joined; case pending.

IDAHO, MINIDOKA PROJECT.

Brinck as Receiver v. *United States.*—Suit for $122,148 in the Court of Claims. During July, 1915, testimony was taken at Boise and Rupert, Idaho, and in March, 1916, in Washington, D. C. Case pending.

* *Mrs. E. C. Kinney* v. *United States.*—Claim made for $6,500, alleged value of certain placer mining claims flooded by Lake Walcott Reservoir. Testimony taken. March 25, 1916, the First Assistant Secretary of the Interior transmitted decision of the department dated February 29, 1916 (D–17194) holding that if claimant would accept $1,000, the matter might be compromised and settled. Claimant accepted offer and delivered relinquishment of all claims involved.

KANSAS, GARDEN CITY PROJECT.

Camden Iron Works v. *United States.*—Suit filed March 14, 1912, in Court of Claims, for $9,271.86. Judgment rendered against the United States for the amount.

MONTANA, BLACKFEET (INDIAN) PROJECT.

George W. Cook and David D. La Breche v. *United States.*—Suit brought in 1911 in the United States District Court for $25,000 damages, and for an injunction. May 5, 1916, a bill was introduced in the Senate (S. 5912) by Senator Walsh, of Montana, providing for an appropriation of $22,400 from the reclamation fund to be paid plaintiffs for the conveyance of all their lands, property, and rights in connection with their allotments at the foot of Lower Two Medicine Lake. Bill referred to Committee on Indian Affairs.

MONTANA, FLATHEAD (INDIAN) PROJECT.

United States v. *F. W. Keeler et al.*—Suit brought in August, 1913, in United States district court to recover possession of land and road. January 24, 1916, a perpetual injunction against the defendants was issued.

United States v. *Herman Knutson Romtviedt.*—Suit filed in May, 1915, in United States district court to recover possession of land. Case dismissed by United States attorney upon representation of the project manager that defendant had vacated the lands of the United States and recommendation by project manager that suit be withdrawn.

**United States* v. *Missoula County*, *Montana.*—Suit filed January 13, 1916, to enjoin defendant county and its officers from selling for taxes reclamation homestead lands on Flathead project. Temporary restraining order issued. April 1, 1916, case submitted on briefs and court has matter under advisement.

**United States* v. *Flathead County*, *Montana.*—Suit filed January 13, 1916, to enjoin defendant county and its officers from selling for taxes reclamation homestead lands on Flathead project. Temporary restraining order issued. April 1, 1916, case submitted on briefs and court has matter under advisement.

**United States* v. *Sanders County*, *Montana.*—Suit filed January 13, 1916, to enjoin defendant county and its officers from selling for taxes reclamation homestead lands on Flathead project. Temporary restraining order issued. April 1, 1916, case submitted on briefs and court has matter under advisement.

MONTANA, FORT PECK (INDIAN) PROJECT.

No litigation.

MONTANA, HUNTLEY PROJECT.

No litigation.

MONTANA, MILK RIVER PROJECT.

No litigation.

MONTANA, MILK RIVER PROJECT—ST. MARY STORAGE UNIT.

George Henkel et al. v. *United States.*—Suit brought in 1913, in United States district court, to compel allotment of lands. Case pending.

MONTANA, SUN RIVER PROJECT.

No litigation.

MONTANA-NORTH DAKOTA, LOWER YELLOWSTONE PROJECT.

Pacific Coast Construction Co. v. *United States.*—Suit brought May 31, 1911, in Court of Claims to recover $34,852.50. Case pending.

Widell-Finley Company et al. v. *United States.*—(See South Dakota—Belle Fourche project.)

**United States* v. *Charles W. Dick.*—Suit brought May 12, 1916, in the United States district court to recover $1,496.00 delinquent water-right charges. Case pending.

NEBRASKA-WYOMING, NORTH PLATTE PROJECT.

S. R. H. Robinson and Son Contracting Co. v. *United States.*—Suit filed November 7, 1913, in Court of Claims for $100,531.86. Case pending.

NEVADA, TRUCKEE-CARSON PROJECT.

United States v. *Rickey Land & Cattle Co.*—Suit filed September 4, 1906, for injunction. Dismissed without prejudice.

Western Company v. *Stone & Webster Construction Co.*, *Truckee General Electric Co.*, *et al.*—Suit brought September 24, 1912, in United States district court, to enjoin changing level of Lake Tahoe. In July, 1915, plaintiff filed amended and supplemental complaint, omitting as defendants the Stone & Webster Construction Co. and Truckee River General Electric Co., and adding as defendants A. P. Davis, Director and Chief Engineer, United States Reclamation Service; D. W. Cole, project manager, Truckee-Carson project; and John F. Truesdell, special assistant to Attorney General of the United States. Case pending.

United States v. *Orr Water and Ditch Co.*—Suit filed March 3, 1913, for adjudication of water rights along Truckee River and tributaries. Case pending.

John Horstman Company v. *United States.*—Suit filed in Court of Claims for $35,000 damages. Case pending.

Natron Soda Co. v. *United States.*—Suit filed in Court of Claims for $170,000 damages. Case pending.

NEW MEXICO, CARLSBAD PROJECT.

United States v. *Charles A. Bigelow et al.*—Proceedings initiated January 15, 1915, for condemnation of land. Referee named to take testimony on controverted questions of fact preliminary to appointment of commissioners for appraisement. Referee's report filed, but no findings of fact or conclusions of law reached by the court and commissioners not yet appointed.

NEW MEXICO, HONDO PROJECT.

United States v. *El Paso & Rock Island Railway Co.*—Suit filed March 17, 1913, in United States district court to adjudicate water rights. Case pending.

NEW MEXICO-TEXAS, RIO GRANDE PROJECT.

El Paso Water Users' Association v. *W. H. Austin et al.*—Suit filed April 29, 1912, in the United States district court for the adjudication of water rights. Case pending.

Oscar C. Snow v. *Francisco Abalos et al.*—Suit filed against about 6,000 defendants October 24, 1912, in the State district court, to adjudicate water rights. Case pending.

United States v. *Lauteria Birner et al.*—Suit filed November 29, 1913, in the United States district court for condemnation of land. No appeal taken and case settled by payment of awards.

United States v. *Jose Antonio Anaya et al.*—Suit filed November 29, 1913, in United States district court for condemnation of land. Report of appraisers filed and confirmed. Appeals, prosecuted by 24 defendants, were tried before juries in January and February, 1916, and settlement was made by payment of the jury awards. Reductions in award were secured in 19 of the 24 cases, the total reductions being between $5,000 and $6,000.

* *Nellie D. Sperry* v. *Chamberino Community Ditch Co. et al.*—Suit filed March 31, 1916, in State district court against employees of the Reclamation Service and others seeking an injunction against the operation of a certain flume across the West Side Canal on account of alleged defective construction and operation which resulted in the flooding of plaintiff's land; also damages for $5,000. Injunction denied. Case pending on claim for damages.

NORTH DAKOTA, NORTH DAKOTA PUMPING PROJECT.

No litigation.

OREGON, UMATILLA PROJECT.

In re Determination of water rights, Umatilla project.—Proceedings begun September 11, 1911, to determine relative rights to the waters of the Umatilla River and tributaries. Decree of determination by the State water board has been published and filed with the local circuit court. Bills of exception thereto filed by claimants, including United States, have been argued and submitted and oral decision by the court has recently been made, though formal decree has not been entered.

OREGON-CALIFORNIA, KLAMATH PROJECT.

Klamath Lake Navigation Co. v. *California, Northeastern R. R. Co. and Southern Pacific R. R. Co.*—United States intervened September 30, 1910. Case pending.

In re Determination water rights, Lost River.—Proceeding before State water board. Case pending.

* *United States* v. *May Walton et al.*—Suit filed March 8, 1916, in United States district court to condemn land. Settled June 10, 1916, for $128.

SOUTH DAKOTA, BELLE FOURCHE PROJECT.

Widell-Finley Co. et al. v. *United States.*—Suit filed February 9, 1912, in the Court of Claims for $226,852.02. The Government has closed its testimony and it is expected the case will be submitted during the fall of 1916.

Belle Fourche Valley Water Users' Association v. *Magruder et al.*—Petition filed July 19, 1913, in State district court for injunction. Case pending.

Samuel H. R. Robinson v. *United States*.—Suit filed in November, 1913, in Court of Claims for $17,145.25. Evidence offered during January and February, 1916, at Chicago and Denver. Case pending.

UTAH, STRAWBERRY VALLEY PROJECT.

No litigation.

WASHINGTON, OKANOGAN PROJECT.

United States v. *Mineral Hill Ditch Co.*—Suit filed April 18, 1915, in United States district court to quiet title and for an injunction. A compromise agreement has been made and judgment will be entered accordingly.

WASHINGTON, YAKIMA PROJECT.

Theodore Weisberger and wife v. *United States*.—Suit filed January 22, 1914, in Court of Claims, for $91,803.33. Evidence has been taken at various times during the year. Case pending.

United States v. *West Side Irrigating Co.*—Action brought June 25, 1912, in the United States district court for injunction. Evidence taken during July and August, 1915, after which briefs were submitted. February 19, 1916, decision handed down enjoining the defendant from diverting water, except as follows: 80 second-feet between July 1 and September 30 of each year, and 34 second-feet during October.

United States v. *Michael J. Sullivan*.—Suit filed July 1, 1914, in United States district court for condemnation of easement. Tried December 15, 1915. Defendant awarded $40, his best offer having been $350.

* *United States* v. *Granger Land Co.*—Suit filed February 23, 1916, in United States district court for operation and maintenance charges under W. I. Co. water-right contract. Amount $612.43 and interest. Claim paid by defendant without trial and judgment of dismissal entered August 5, 1916.

**United States* v. *Elza Dean and Granger Land Co.*—Suit filed February 23, 1916, in United States district court for operation and maintenance charges due under W. I. Co. water-right contract. Amount $247.12 and interest. Claim paid by defendant without trial and judgment of dismissal entered May 3, 1916.

* *United States* v. *Oswald S. Thomas*.—Suit filed June 28, 1916, in the United States district court for operation and maintenance charges due under the W. I. Co. water-right contract. Amount, $96.80. Case pending.

* *United States* v. *F. L. Watson*.—Suit filed June 28, 1916, in United States district court for operation and maintenance charges under W. I. Co. water-right contract. Amount, $131.53. Case pending.

* *United States* v. *William J. Duffy*.—Suit filed June 28, 1916, in United States district court for operation and maintenance charges under W. I. Co. water-right contract. Amount, $82.60. Case pending.

**United States* v. *Grant McLean*.—Suit filed June 29, 1916, in United States district court for operation and maintenance charges under W. I. Co. water-right contract. Amount, $46.48. Case pending.

WYOMING, JACKSON LAKE ENLARGEMENT.

United States v. *B. D. Sheffield.*—Suit filed June 20, 1914, in the Federal court to condemn lands. Settlement has been agreed upon for exchange of a small tract of public land for the private lands needed by the United States. Deeds conveying the private lands to the United States have been placed in escrow. A special act of Congress authorizing this exchange has been drafted, passed by both Houses of Congress, and was signed by the President on June 28, 1916.

WYOMING, SHOSHONE PROJECT.

United States Fidelity & Guaranty Co. v. *United States.*—Suit brought in 1912 in the Conrt of Claims for the recovery of $822,777.58. Testimony taken. United States awaiting filing of plaintiff's brief.

DECISIONS OF THE SECRETARY OF THE INTERIOR.

A digest of some important decisions which have been rendered by the Secretary of the Interior during the fiscal year relative to operations under the reclamation law is given below under suitable headings. A few decisions by the Comptroller of the Treasury are also included.

ASSIGNMENT OF FARM UNIT TO MINOR.

The department, in letter to the Commissioner of the General Land Office (not published), dated February 1, 1916, held that minors are not qualified to take by assignment farm units upon which reclamation charges have not been paid in full.

CALENDAR YEAR.

The department on May 24, 1916, construed the words "calendar year" as used in section 6 of the reclamation extension act of August 13, 1914 (38 Stat., 686), as meaning a year from January 1 to December 31, inclusive.

COMMUNITY CENTER PARK IN TOWNSITE IS NOT UNDER ACT OF OCTOBER 5, 1914.

The department on June 18, 1915, held that a park within a townsite established under act of April 16, 1906 (34 Stat., 116), is not a country park, public playground, or community center contemplated by act of October 5, 1914 (38 Stat., 727), and water can not be delivered thereon free of charge.

CONTRACTS—FINDINGS OF FACT AS TO DELAY.

The authority conferred upon an administrative officer, under a contract, to determine the extent of the delay in the completion of contract work, caused by the Government, does not authorize such officer to make a mere estimate as to the period of such delay, and unless the number of days of delay is stated in a specific finding of fact no liquidated damages can be collected. (22 Compt. Dec., 329.)

CONTRACTS—RENT AS BETWEEN BUREAUS OF GOVERNMENT.

Since, in the absence of specific statutory authority, one department or branch of the Government is not authorized to enter into contracts with another such department or branch, and to make payments thereunder, the General Land Office may not lawfully pay rent to the Reclamation Service for the use of a part of a warehouse when the reclamation fund is not depleted by such use. However, any cost of maintenance of the warehouse may be apportioned properly between the Reclamation Service and the General Land Office. (22 Compt. Dec., 684.)

ASSIGNMENT—DESERT ENTRY WITHIN RECLAMATION PROJECT, ACT JULY 24, 1912.

Where a desert land entry within a reclamation project is assigned in part under the act of July 24, 1912, the entry should be subdivided into farm units as required by paragraphs 124 to 126 of the regulations of May 18, 1916, but where such an entry is assigned in its entirety the establishment of a farm unit is unnecessary. (44 L. D., 386.)

FUNDS RECEIVED BY THE RECLAMATION SERVICE—DISPOSITION OF.

Where funds, paid to the Reclamation Service, pursuant to contract, by an irrigation company, to cover the cost of work being done by that service for the benefit of said company, are expended for commissary and other supplies, which are resold during the progress of the work, the receipts from such resales are to be applied to the completion of the work and are not to be covered into the reclamation fund as provided by the act of March 3, 1905. (22 Compt. Dec., 289.)

HOMESTEAD ENTRIES—NONCONTIGUOUS LANDS.

An Executive order withdrawing a strip of land under the act of June 25, 1910 (36 Stat., 847), for a right of way for electric-transmission lines does not render the tracts lying on opposite sides of the withdrawn strip noncontiguous, and an entry embracing tracts on both sides of such strips may be allowed, but the entry papers and patent should contain an excepting clause excluding the area embraced in the withdrawal. (First Asst. Secretary, Feb. 6, 1915; 43 L. D., 551.)

PRACTICE—RIGHT OF APPEAL.

Any matter at issue arising in connection with and within the jurisdiction of the Reclamation Service should first be decided by the Reclamation Service, with right of appeal to the Secretary of the Interior. (44 L. D., 11.)

RECLAMATION HOMESTEAD—SETTLEMENT—SCHOOL SECTION.

A settler on unsurveyed land in a school section who, after survey and after withdrawal of the land under the reclamation act as susceptible of reclamation under an irrigation project, was permitted to make entry for the full area of 160 acres, must conform his entry to a farm unit, but is entitled, under the provisions of the act of June 23, 1910, to assign the remaining portion of his entry; and the rights acquired by such settlement and entry bar the attachment of any rights to the land on behalf of the State under its school grant.

Departmental decisions of March 11 and May 13, 1912 (40 L. D., 586, 589), modified, and decision in William Boyle (38 L. D., 603) overruled in so far as in conflict. (44 L. D., 331.)

RESIDENCE—PRIVATE LANDS.

The residence requirement of the reclamation act of June 17, 1902, with reference to private lands is fully complied with if at the time the water-right application is made the applicant is a bona fide resident upon the land or within the neighborhood; that is, not a pretended but a real resident at that time. After making application further residence is not required of such applicants, and final proof may therefore be made under the act of August 9, 1912 (37 Stat., 265), without the necessity of proving residence at the time proof is offered. (First Asst. Secretary, Apr. 19, 1916.)

TELEPHONE LINES ON PUBLIC LANDS—EXCEPTIONS IN PATENTS.

Where telephone lines have been actually constructed upon public lands of the United States, including national forest lands, and are being maintained and operated by the United States, appropriate maps or field notes thereof should be furnished the Commissioner of the General Land Office and notation thereof made upon the tract books of that office; and if the lands be thereafter disposed of under any of the public-land laws, the final certificate and patent should except the telephone line and appurtenances, with the right of the United States to maintain and operate the same. (44 L. D., 359; 44 L. D., 412.)

WATER-RIGHT PAYMENTS—CREDIT FOR.

The Reclamation Service is authorized to accept water-right applications in all cases of new entries made under Act of March 4, 1915 (38 Stat., 1215), allowing the entryman credit for his payments under the extension act to the amount of which he is justly entitled by reason of payments made on his original water-right application. Also in cases of assignments under paragraph 109 of the General Reclamation Circular approved May 18, 1916, the Reclamation Service is authorized to accept water-right applications under the extension act, allowing the assignee credit upon his water-right payments to the amount of the credits assigned to him as provided in said paragraph 109. (44 L. D., 544.)

WATER USERS' ASSOCIATIONS AND IRRIGATION DISTRICTS, REPRESENTING THE SEVERAL PROJECTS.

ARIZONA, SALT RIVER PROJECT.

Salt River Valley Water Users' Association, incorporated February 9, 1903. Contract with Secretary of the Interior June 25, 1904, guaranteeing repayment cost of system.

ARIZONA-CALIFORNIA, YUMA PROJECT.

Yuma County Water Users' Association, incorporated. Contract with Secretary of the Interior May 31, 1906, guaranteeing repayment cost of system.

CALIFORNIA, ORLAND PROJECT.

Orland Unit Water Users' Association, incorporated March 27, 1907. Contract with Secretary of the Interior April 3, 1909, guaranteeing repayment cost of system.

COLORADO, GRAND VALLEY PROJECT.

Grand Valley Water Users' Association, incorporated February 7, 1905. Contract with Secretary of the Interior February 13, 1913, guaranteeing repayment cost of system.

COLORADO, UNCOMPAHGRE VALLEY PROJECT.

Uncompahgre Valley Water Users' Association, incorporated May 11, 1903. Contract with Secretary of the Interior December 3, 1904, guaranteeing repayment cost of system.

IDAHO, BOISE PROJECT.

Payette-Boise Water Users' Association, incorporated September 9, 1904. Contract with Secretary of the Interior February 13, 1906, guaranteeing repayment cost of system.

IDAHO, MINIDOKA PROJECT.

South Side Minidoka Water Users' Association (Ltd.), incorporated January 20, 1908. No contract.

Minidoka Irrigation District, formed July 22, 1913. Contract with Secretary of the Interior October 21, 1915, to act as fiscal agent.

KANSAS, GARDEN CITY PROJECT.

Finney County Water Users' Association, incorporated October 18, 1905. Contract with Secretary of the Interior December 28, 1905, guaranteeing repayment cost of system.

Huntley Project Water Users' Association, not incorporated. No contract.

MONTANA, MILK RIVER PROJECT.

Lower Milk River Water Users' Association, incorporated April 27, 1905. Contract with Secretary of the Interior February 10, 1909, guaranteeing repayment cost of system.

Upper Milk River Water Users' Association, incorporated June, 1907. No contract guaranteeing repayment.

MONTANA, SUN RIVER PROJECT.

Fort Shaw Water Users' Association. Not incorporated. No contract.

MONTANA-NORTH DAKOTA, LOWER YELLOWSTONE PROJECT.

Lower Yellowstone Water Users' Association, incorporated January 12, 1905. Contract with Secretary of the Interior October 25, 1905, guaranteeing repayment cost of system.

NEBRASKA-WYOMING, NORTH PLATTE PROJECT.

North Platte Valley Water Users' Association, incorporated May 25, 1905. Contracts with Secretary of the Interior April 25, 1906, and June 23, 1909, guaranteeing repayment cost of system.

NEVADA, TRUCKEE-CARSON PROJECT.

Truckee-Carson Farmers' Association. Not incorporated. No contract.

NEW MEXICO, CARLSBAD PROJECT.

Pecos Water Users' Association, incorporated October 15, 1904; articles of incorporation amended January 14, 1915. Contracts with Secretary of the Interior March 19, 1906; February 21, 1912, and March 12, 1915, guaranteeing repayment cost of system. Contract with Secretary of the Interior August 30, 1915, to act as fiscal agent.

NEW MEXICO, HONDO PROJECT.

Rio Hondo Reservoir Water Users' Association, incorporated June 16, 1904. Contract with Secretary of the Interior December 31, 1904, guaranteeing repayment cost of system.

NEW MEXICO-TEXAS, RIO GRANDE PROJECT.

Elephant Butte Water Users' Association, incorporated January 12, 1905. Contract with Secretary of the Interior June 27, 1906, guaranteeing repayment cost of system.

El Paso Valley Water Users' Association, incorporated June 17, 1905. Contract with Secretary of the Interior June 27, 1906, guaranteeing repayment cost of system.

NORTH DAKOTA, NORTH DAKOTA PUMPING PROJECT.

Williston Water Users' Association, incorporated May 22, 1905. Contract with Secretary of the Interior May 23, 1906, guaranteeing repayment cost of system.

Buford-Trenton Water Users' Association, incorporated in 1905. Contract with Secretary of the Interior May 23, 1906, guaranteeing repayment cost of system.

OKLAHOMA, LAWTON PROJECT.

Lawton Water Users' Association, incorporated September 23, 1914. No contract.

OREGON, UMATILLA PROJECT.

Umatilla River Water Users' Association, incorporated in 1906. Contract with Secretary of the Interior April 25, 1906, guaranteeing repayment cost of system.

OREGON-CALIFORNIA, KLAMATH PROJECT.

Klamath Water Users' Association, incorporated. Contract with Secretary of the Interior November 6, 1905, guaranteeing repayment cost of system.

SOUTH DAKOTA, BELLE FOURCHE PROJECT.

Belle Fourche Valley Water Users' Association, incorporated June 27, 1904. Contracts with Secretary of the Interior April 29, 1905, and January 24, 1911, guaranteeing repayment cost of system.

UTAH, STRAWBERRY VALLEY PROJECT.

No water users' association or irrigation district.

WASHINGTON, OKANOGAN PROJECT.

Okanogan Water Users' Association, incorporated October 28, 1905. Contracts with Secretary of the Interior April 16, 1906 and May 11, 1912, guaranteeing repayment cost of system.

WASHINGTON, YAKIMA PROJECT.

Tieton Water Users' Association, incorporated March 10, 1906. Contract with Secretary of the Interior April 12, 1906, guaranteeing repayment cost of system. Contract October 29, 1915, to act as fiscal agent and take over operation and maintenance.

Sunnyside Water Users' Association, incorporated March 10, 1906. Contract with Secretary of the Interior May 7, 1906, guaranteeing repayment cost of system.

WYOMING, SHOSHONE PROJECT.

Shoshone Water Users' Association, not incorporated. No contract.

PURCHASES OF RIGHTS AND PROPERTY.

The following purchases of rights and property were made during the fiscal year ending June 30, 1916:

Purchases of rights and property.

ARIZONA, SALT RIVER PROJECT.

Vendor.	Description.	Consideration.	Date of deed.
Arnold, D. M., and wife	Improvements on 0.30 acre in SE. ¼ SW. ¼, sec. 32, T. 1 S., R. 5 E.	$40.00	[1]Jan. 29, 1916
Chandler, H. L., and wife	2.42 acres in SE. ¼, sec. 9, T. 1 S., R. 5 E.	383.00	Nov. 24, 1915
Dobson, Harold Argue, and wife.	1.51 acres in SE. ¼, sec. 7, T. 1 S., R. 5 E.	226.00	Apr. 12, 1915
Hicks, Frances C., and husband.	0.37 acre in NW. ¼ SW. ¼, sec. 27, T. 2 N., R. 3 E.	111.00	June 5, 1915
Jones, C. B.; Morrison, Roland, and wife.	1.22 acres in SW. ¼, sec. 32, T. 1 N., R. 6 E.	231.30	Jan. 7, 1916
Peterson, Charles A., and wife.	1.99 acres in SW. ¼, sec. 9, T. 1 S., R. 5 E.	365.00	Dec. 4, 1915
Do	1 acre in SW. ¼ NW. ¼, sec. 9, T. 1 S., R. 5 E.	265.00	Oct. 22, 1915
Riordan, E. M	Improvements on 2 acres in NW. ¼, sec. 10, T. 1 S., R. 5 E.	20.00	[1]Jan. 25, 1915
Smith, Louise P	Improvements on 1.22 acres in NW. ¼, sec. 32, T. 1 N., R. 6 E.	26.10	[1]Oct. 26, 1914
Sturgeon, Mrs. J. E	Improvements on SW. ¼ NW. ¼ and W. ½ SW. ¼ sec. 36, T. 4 N., R. 13 E.	3,000.00	[1]May 24, 1915
Taggart, S. B., and wife, and Taggart, S. B., trustee.	0.66 acre in NW. ¼, sec. 8, T. 1 S., R. 6 E.	66.00	July 8, 1915
Taylor, H. H	Improvements on 1.42 acres in NE. ¼, sec. 30, T. 1 N., R. 6 E.	42.15	[1]Oct. 29, 1914
Tway, E. D., and wife	0.67 acre in NE. ¼, sec. 14, T. 1 N., R. 5 E.	150.00	June 18, 1915
Wallace, John S., James F., and Rachel.	1.15 acres in SE. ¼, sec. 13, T. 1 N., R. 5 E.	115.00	May 19, 1915
Wallace, W. H., and wife	Improvements on 1 acre in W. ½ NW. ¼, sec. 19, T. 1 N., R. 6 E.	27.00	[1]Oct. 22, 1914

ARIZONA-CALIFORNIA, YUMA PROJECT.

Behan, Albert	Improvements on part of N. ½ SW. ¼, sec. 21, T. 9 S., R. 24 W., G. & S. R. M.	$91.00	Dec. 17,
Caldwell, G. M	Improvements on part of NE. ¼ SW. ¼, sec. 24, T. 8 S. R. 24 W., G. & S. R. M.	172.50	Aug.
Meadow, William M., and wife.	Improvements on part of W. ½ SE. ¼, sec. 33, T. 8 S., R. 24 W., G. & S. R. M.	104.00	Dec.
Miller, B. E	Improvements on part of Unit F, T. 16 S., R. 23 E., S. B. M.	215.00	June
Morgan, Frank R	Improvements on part of W. ½ NE. ¼, sec. 7, T. 10 S., R. 24 W., G. & S. R. M.	121.00	De
Nunnaley, B. L., and wife	Improvements on part of S. ½ NE. ¼ SE. ¼, sec. 25, T. 8 S., R. 24 W., G. & S. R. M.	86.80	F
Schutz, George W., and wife	Improvements on part of SW. ¼, sec. 9, T. 10 S., R. 24 W., G. & S. R. M.	24.00	

CALIFORNIA, ORLAND PROJECT.

Orland Unit Water Users' Association.	Strip of land across E. ½ SW. ¼, sec. 33, T. 23 N., R. 4 W., M. D. B. & M.	$1.

COLORADO, GRAND VALLEY PROJECT.

Skinner, R. M	0.27 acre in SE. ¼ SW. ¼, sec. 3, T. 11 S., R. 98 W., sixth P. M.

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[1] No deed was given to United States and date shown is date of contract, as
ments only.

Purchases of rights and property—Continued.

COLORADO, UNCOMPAHGRE VALLEY PROJECT.

Vendor.	Loutsenhizer water rights (amount in second-feet).	Consideration.	Date of deed.
Agnew, Charles C	$\frac{1}{4}$	$200.00	Feb. 8, 1916
Allen, E. R	$\frac{1}{5}$	160.00	Feb. 14, 1916
Baldwin, Joseph B	$\frac{1}{8}$	100.00	July 10, 1915
Banta, Nannie E	$\frac{29}{128}$	181.25	Jan. 20, 1916
Bartley, L. D	$\frac{1}{8}$	100.00	July 3, 1915
Baxter, Addison Josiah	$\frac{1}{8}$	100.00	June 30, 1915
Bellamy, Wiley O	$\frac{1}{2}$	400.00	Oct. 28, 1915
Blamey, Wm. and Daisy May	$1\frac{1}{2}$	1,200.00	Nov. 27, 1915
Block, Chas. A	$2\frac{1}{80}$	1,610.00	Sept. 2, 1915
Brevick, Baard A	$1\frac{1}{3}$	1,066.67	July 6, 1915
Briney, Peter L	$\frac{10}{11}$	727.27	Mar. 11, 1916
Brower, William A	1	800.00	Nov. 4, 1915
Brown, Jas. G	$\frac{1}{4}$	200.00	Oct. 15, 1915
Brown, Jas. H	$\frac{5}{8}$	500.00	July 6, 1915
Buddecke, A. E	1	800.00	Nov. 19, 1915
Cade, Ellena B. and Martin	$\frac{1}{2}$	400.00	Sept. 11, 1915
Catlin, F. D	$1\frac{1}{4}$	1,000.00	Feb. 11, 1916
Champion, Wm. V	$\frac{1}{2}$	400.00	June 30, 1915
Christainson, Edward P	$\frac{1}{2}$	400.00	Jan. 8, 1916
Christie, Laura J	1	800.00	July 14, 1915
Christie, John F	$\frac{1}{2}$	400.00	July 6, 1915
Collins, W. J. and Mary M	$\frac{1}{5}$	160.00	June 10, 1916
Condit, Phillip M. and Celestia H	$\frac{1}{4}$	200.00	July 9, 1915
Corrick, William H. and Clelia	$\frac{3}{8}$	300.00	Nov. 17, 1915
Crippa, David and Vittoria	0.153	122.40	June 7, 1916
Davis, A. M	1	800.00	Apr. 7, 1916
Deeble, John	$\frac{1}{2}$	400.00	Apr. 30, 1915
DeGuelle, Ed. and Adolph	$\frac{3}{4}$	600.00	Oct. 16, 1915
Denniston, Mary E	$\frac{1}{20}$	40.00	June 13, 1916
DeRobles, Joseph	$\frac{1}{2}$	400.00	Dec. 17, 1915
Duncan, George	$\frac{3}{16}$	150.00	Sept. 23, 1915
Duncan, J. A	$\frac{1}{4}$	200.00	Oct. 26, 1915
Faast, Edmund	0.3375	270.00	Nov. 11, 1915
Fairlamb, Millard	$\frac{5}{16}$	250.00	Nov. 13, 1915
Fitts, Flora E. Nelson	$\frac{1}{2}$	400.00	July 6, 1915
Fitts, Warren	$1\frac{1}{2}$	1,200.00	July 6, 1915
Frost, Gus A	1	800.00	Nov. 26, 1915
Fuerstenberg, Henry	$\frac{1}{2}$	400.00	Jan. 4, 1916
Gerlach, George	$\frac{3}{4}$	600.00	June 29, 1915
Goddard, Ed. et al	1	800.00	July 14, 1915
Goddard, E. A	$\frac{1}{2}$	400.00	June 1, 1916
Goldsmith, Jas. W	$\frac{7}{8}$	700.00	Nov. 27, 1915
Gough, G. W	$\frac{1}{4}$	200.00	Oct. 11, 1915
Gunnison Tunnel Investment Co	$4\frac{1}{4}$	3,401.00	Mar. 22, 1916
Hanna, L. W	$\frac{1}{2}$	400.00	June 21, 1916
Harris, Abel W	1	800.00	Nov. 27, 1915
Harrison, Elmore C	$\frac{5}{32}$	125.00	Dec. 6, 1915
Head, Martha L	$\frac{3}{8}$	300.00	July 24, 1915
Headington, G. F	$\frac{1}{4}$	200.00	Sept. 10, 1915
Heinselman, Wm. J	$\frac{5}{8}$	500.00	Sept. 4, 1915
Hodge, Maude M	$\frac{1}{2}$	400.00	Jan. 4, 1916
Huntley, F. W	$\frac{1}{8}$	100.00	Feb. 15, 1916
Johnson, J. R. and Cora	$\frac{1}{2}$	400.00	Sept. 9, 1915
Krebs, J. F	$\frac{1}{2}$	400.00	Sept. 21, 1915
Kuhnley, Lester	$\frac{3}{8}$	300.00	Nov. 29, 1915
Kulp, Anna	$\frac{29}{128}$	181.25	June 21, 1916
Lindeback, Peter A., et al	$\frac{1}{4}$	200.00	Nov. 8, 1915
Maffenbeir, Frank	$\frac{1}{2}$	400.00	Oct. 2, 1915
Marcheski, James	$\frac{7}{8}$	700.00	May 13, 1916
Marshall, Willis M	$3\frac{1}{64}$	2,412.50	May 22, 1916
Martineit, C	$\frac{1}{11}$	72.72	July 27, 1915
Maurer, E. H	$\frac{4}{15}$	213.33	July 26, 1915
Monell, Townsend W., et al	2	1,600.00	Oct. 30, 1915
Moore, Irena A	$\frac{5}{8}$	500.00	Dec. 31, 1915
McReynolds, John	1	800.00	June 29, 1915
Nowell, Richard H	1	800.00	Nov. 1, 1915
Nusse, F. J	$\frac{4}{5}$	640.00	July 6, 1915
Osborn, Eli L	1	800.00	Sept. 17, 1915
Platt, Frank	$\frac{1}{2}$	400.00	May 27, 1916
Price, Carl L	$\frac{1}{8}$	100.00	Feb. 11, 1916
Rhyan, Annie C., et al	0.885	654.00	July 31, 1915
Richardson, R. H	$\frac{1}{4}$	200.00	Apr. 13, 1916
Rider, Margaret M	$\frac{3}{8}$	300.00	Apr. 15, 1916
Rinehart, D. N	$\frac{1}{4}$	200.00	Jan. 20, 1916
Rowen, C. Ray	$\frac{3}{4}$	600.00	Aug. 18, 1915
Scheibler, Henry A., et al	$\frac{1}{4}$	200.00	Mar. 13, 1916
Seeley, Paul S	$1\frac{3}{4}$	1,400.00	Sept. 28, 1915

Vendor.	Loutsenhizer water rights (amount in second-feet).	Consideration.	Date of deed.
Selig Investment Co	1⅛	$900.00	Nov. 29, 1915
Sherman, D. E	¼	200.00	Aug. 31, 1915
Splinter, Maria Elizabeth	¼	200.00	Nov. 3, 1915
Stalder, MaryAnn et al	⅛	100.00	Jan. 20, 1916
Starr, Susan E	⅝	500.00	Sept. 23, 1915
St. James, Anna B	½	400.00	Oct. 19, 1915
Suttle, C. E	2	1,600.00	Sept. 4, 1915
Tilden, G. W	1½	1,200.00	Nov. 12, 1915
Vaughn, Harrison S	¼	200.00	June 30, 1915
Veatch, Presley B	1	800.00	June 30, 1915
Virtue, Patrick P	⅜	300.00	Sept. 7, 1915
Youngblood, Joseph P	1	800.00	June 30, 1915

IRONSTONE AND IRONSTONE EXTENSION WATER RIGHTS REPRESENTED BY SHARES OF STOCK.

Vendor.	Number of shares Ironstone.	Number of shares extension.	Consideration.	Date of deed.
Anderson, John F	3		$1,200.00	Oct. 20, 1915
Armentrout, E. S	2		800.00	Jan. 8, 1916
Baird, Leonard	5		2,000.00	Oct. 22, 1915
Broughton, G. P	4	4	1,600.00	Jan. 15, 1916
Brown, Andrew J	5		2,000.00	Nov. 13, 1915
Brown, George H	3		1,200.00	Jan. 4, 1916
Bullock, Caroline	2		800.00	Nov. 2, 1915
Cook, D. P	4	4	1,600.00	Apr. 14, 1916
Cook, Louis A	3	5	1,200.00	Feb. 29, 1916
Conway, Mary Frances	1		400.00	Feb. 10, 1916
Conway, Mary Frances, et al	5	4	2,000.00	Mar. 20, 1916
Cotter, J. E. and Anna H	8		3,200.00	Nov. 26, 1915
Craig, Mrs. J. O	4	4	1,600.00	Apr. 6, 1916
Crockett, Katherine N	2	2	800.00	Dec. 15, 1915
Danbom, A. P., et al	6	6	2,400.00	Jan. 7, 1916
Dennis, E. G	½		200.00	Apr. 18, 1916
Dickerson, Mrs. Ella and Joel	8		3,200.00	Dec. 13, 1915
Duncan, James	1		400.00	Feb. 19, 1916
Ellicker, Arthur K	2		800.00	Oct. 26, 1915
Erickson, A. M	5		2,000.00	Oct. 30, 1915
Esty, Ray S	1½	1½	600.00	Dec. 21, 1915
First National Bank (Olathe)	2		800.00	Feb. 19, 1916
Foster, C. P	2		800.00	Jan. 14, 1916
Freeland, Henry M	4		1,600.00	Dec. 9, 1915
French, Gilbert E	2½	1	1,000.00	Sept. 28, 1915
Gehrig, Chas. and Lewis	½		200.00	Oct. 26, 1915
Hartig, Genevieve	2	2	800.00	Nov. 4, 1915
Hartig, Genevieve, et al	6	6	2,400.00	Nov. 4, 1915
Hartman, E. P	2		800.00	Oct. 18, 1915
Hay, C. G	1½		600.00	Apr. 10, 1916
Hickman, R. S	4	4	1,600.00	Jan. 3, 1916
Johnson, Gustaf	1		400.00	Nov. 1, 1915
Jones, Quincy, M. and P. W	3	3	1,200.00	Sept. 30, 1915
Jones, Z. I	1⅔		666.65	Feb. 14, 1916
Kloster, Ben	½		200.00	Dec. 18, 1915
Kotik, Joseph	5	5	2,000.00	Nov. 15, 1915
Latham, Charlotte, F	1⅓		533.33	Nov. 5, 1915
Lord, Robert	1		400.00	Jan. 4, 1916
Markley, M. C	1	1	400.00	Nov. 6, 1915
Markley, J. N. and Mary B	4	4	1,600.00	Jan. 15, 1916
Martin, I. A	½		200.00	Apr. 10, 1916
Maryott, Chas. C	14	16	5,600.00	Nov. 6, 1915
Maxwell, Wm. G	4		1,600.00	Apr. 14, 1916
Meldrum, Margaret A	6	4	2,400.00	Oct. 25, 1915
Morman, A. S	1½		600.00	Nov. 10, 1915
McClurg, Lucy I	1		400.00	June 15, 1916
McKnight, Geo. A	4	4	1,600.00	Apr. 17, 1916
Osborn, Grace P	3	1	1,200.00	Feb. 2, 1916
Perry, Dennis	1		400.00	Oct. 25, 1915
Price, Henry J	4	4	1,600.00	Mar. 28, 1916
Quinlan, F. B	1½		600.00	Jan. 7, 1916
Reshaw, Sarah A	4	4	1,600.00	Feb. 29, 1916
Rhodes, Sherman	1		400.00	Dec. 14, 1915
Rhodes, Z. M	2		800.00	Oct. 26, 1915
Rhonemus, Clementine M	1		400.00	Dec. 31, 1915
Rickelton, Anderson	3		1,200.00	Jan. 14, 1916

Purchases of rights and property—Continued.

COLORADO, UNCOMPAHGRE VALLEY PROJECT—Continued.

IRONSTONE AND IRONSTONE EXTENSION WATER RIGHTS REPRESENTED BY SHARES OF STOCK—continued.

Vendor.	Number of shares Ironstone.	Number of shares extension.	Consideration.	Date of deed.
Rickelton, Anderson	½	....	$200.00	June 1, 1916
Scott, Leroy W	7	7	2,800.00	Mar. 17, 1916
Selig Investment Co	3	....	1,200.00	Feb. 26, 1916
Setser, Charles, and Deist, Henry C	3	1	1,200.00	Oct. 27, 1915
Shearer, E. C	1	1	400.00	Oct. 29, 1915
Shields, F. W. and Louisa E	7	....	2,800.00	Oct. 23, 1915
Stockham, A. H	2	2	800.00	Oct. 23, 1915
Toothaker, Mary E., et al	2	....	800.00	Jan. 8, 1916
Van De Burg, Emma N., et al	2	....	800.00	Jan. 22, 1916
Walstrom, Oscar L	1	....	400.00	Oct. 22, 1915
Warner, George	1½	1½	600.00	Oct. 25, 1915
Weeks, S. W	12	12	4,800.00	May 6, 1916
Wilson, A. E., and Kellenberg, G. H	6	6	2,400.00	Oct. 22, 1915
Wright, A. S	3½	....	1,400.00	Oct. 26, 1915
Young, Ernest L	8½	2	3,300.00	Sept. 27, 1915
Wilson, Georgia Shaw	¾	....	300.00	Mar. 27, 1916

Vendor.	Description.	Consideration.	Date of deed.
	RIGHTS OF WAY.		
Anderson, John F	Portion of SW. ¼ SE. ¼, containing 2.66 acres; portion of NW. ¼ SE. ¼ sec. 16, T. 50 N., R. 10 W., N. M. P. M., containing 0.72 acre.	$1.00	July 13, 1915
Anderson, K. H	Portion of SW. ¼ SE. ¼ sec. 2, T. 50 N., R. 11 W., N. M. P. M., containing 2.16 acres.	175.00	Mar. 20, 1916
Belgardt, Albert	Government road across SW. ¼ NW. ¼ sec. 29, T. 49 N., R. 7 W., N. M. P. M.	1.00	Jan. 3, 1916
Brown, George H	Portion of NW ¼ SW. ¼ sec. 9, T. 50 N., R. 10 W., containing 0.17 acre.	1.00	Nov. 8, 1915
Browne, Dewit, et al	Portion of N. ½ SW. ¼ sec. 18, T. 50 N., R. 10 W., N. M. P. M., containing 3.36 acres.	100.00	Mar. 24, 1916
Brown, Ralph D., et al	Portion of NE. ¼ NE. ¼ sec. 11, T. 50 N., R. 11 W., N. M. P. M., containing 1.36 acres.	75.00	Dec. 3, 1915
Caley, Paul G	Government road across the NW. ¼ NE. ¼ E.; NW. portion sec. 29, T. 49 N., R. 7. W., N. M. P. M.	1.00	Dec. 13, 1915
Caseley, Grace E., et al	Portion of SE. ¼ NE. ¼ sec. 31, T. 51 N., R. 10 W., containing 1.43 acres.	1.00	Jan. 6, 1916
Casner, B. A	Portion of SW. ¼ SE. ¼ sec. 6, T. 50 N., R. 10 W., containing 1.84 acres.	1.00	Aug. 19, 1915
Casner, Benjamin A	Portion of NW. ¼ SE. ¼ sec. 12, T. 50 N., R. 11 W., containing 2.62 acres.	200.00	Dec. 27, 1915
Clark, Albert B., et al	Portion of SE. ¼ NW. ¼ containing 0.25 acre; also portion of SE. ¼ NW. ¼ W. ½ NW. ¼ sec. 12, T. 50 N., R. 11 W., N. M. P. M., containing 6.32 acres.	225.00	Do.
Cleveland, Amelia	Portion of NE. ¼ SE. ¼ sec. 30, T. 51 N., R. 10 W., N. M. P. M., containing 1.22 acres.	135.00	June 21, 1916
Danbom, A. P., et al	Portion of SE. ¼ SE. ¼ sec. 2, T. 50 N., R. 11 W., N. M. P. M., containing 2.30 acres.	125.00	Mar. 7, 1916
Dennis, E. G	Portion of NW. ¼ NW. ¼ sec. 9, T. 50 N., R. 10 W., containing 0.29 acre.	25.00	Mar. 22, 1916
Dickey, Ada A., et al	Portion of S. ½ E. ½ SE. ¼ containing 4.6 acres; also portion of S. ½ N. ½ SE. ¼ containing 0.38 acre, all in sec. 36, T. 48 N., R. 9 W., N. M. P. M.	300.00	May 28, 1915
Dill, Thomas L., et al	Portion of SE. ¼ SE. ¼ sec. 21; E. ½ NE. ¼ sec. 28, T. 50 N., R. 10 W., N. M. P. M., containing 10.61 acres, more or less.	400.00	Jan. 4, 1916
Dolan, Mary M	Portion of W. ½ SW. ¼ sec. 9, T. 50 N., R. 10 W., containing 0.51 acre.	1.00	Mar. 20, 1916
Do	Portion of SW. ¼ SW. ¼; NW. ¼ SW. ¼ sec. 9, T. 50 N., R. 10 W., N. M. P. M., containing 1.58 acres.	1.00	Nov. 13, 1915
Duncan, James and Ida	Portion of NW. ¼ NW. ¼ sec. 5, T. 50 N., R. 10 W., containing 1.69 acres.	100.00	Mar. 23, 1916
Edie, J. A	Portion of SE. ¼ SW. ¼ sec. 2, T. 50 N., R. 11 W., containing 2.03 acres.	150.00	Feb. 11, 1916
Elicker, Arthur K	Portion of W. ½ SE. ¼ SE. ¼ sec. 8, T. 50 N., R. 10 W., N. M. P. M., containing 1.03 acres.	225.00	Apr. 28, 1916
Felix, Charles W	Portion of SE. ¼ NE. ¼ sec. 30, T. 51 N., R. 10 W., N. M. P. M., containing 1.24 acres.	135.00	June 6, 1916
Fonten, Albert J	Government road across the SE. ¼ SW. ¼; SW. ¼ SE. ¼ sec. 29 and NE. ¼ NW. ¼; NW. ¼ NE. ¼ sec. 32, T. 49 N., R. 7 W., N. M. P. M.	1.00	Nov. 22, 1915
Freeland, Henry M	Portion of SE. ¼ SE. ¼ sec. 31; SW. ¼ SW. ¼ sec. 32, T. 51 N., R. 10 W., N. M. P. M., containing 2.05 acres.	420.00	Apr. 12, 1916

Purchases of rights and property—Continued.

COLORADO, UNCOMPAHGRE VALLEY PROJECT—Continued.

Vendor.	Description.	Consideration.	Date of deed.
	RIGHTS OF WAY—continued.		
Garoutte, Clara F	Portion of NE. ¼ SE. ¼; SE. ¼ NE. ¼ sec. 12, T. 50 N., R. 11 W., containing 4.43 acres.	$200.00	Feb. 7, 1916
Garoutte, James B	Portion of SE. ¼ SE. ¼ sec. 12, T. 50 N., R. 11 W., containing 2.58 acres.	100.00	Jan. 10, 1916
Garoutte, J. B	Portion of SW. ¼ NE. ¼ sec. 12, T. 50 N., R. 11 W., containing 0.41 acre.	1.00	Aug. 11, 1915
Hawkyard, A. T	A portion of the NW. ¼ SE. ¼ sec. 18, T. 50 N., R. 10 W., N. M. P. M., containing 0.79 acre.	1.00	Do.
Hay, C. G	Portion of the SW. ¼ NW. ¼ sec. 9, T. 50 N., R. 10 W., N. M. P. M., containing 0.30 acre.	1.00	Nov. 19, 1915
Heath, Charles A	Portion of SW. ¼ NE. ¼ sec. 26, T. 49 N., R. 9 W., N. M. P. M., containing 0.59 acre.	250.00	Dec. 18, 1915
Hickey, Abraham L	Right of way for Gunnison tunnel across the SW. ¼ NW. ¼, NW. ¼ SW. ¼ sec. 19, T. 49 N., R. 7 W., N. M. P. M.	1.00	Nov. 15, 1915
Hodge, Maude M	Portion of SE. ¼ SE. ¼, SW. ¼ SE. ¼, NW. ¼ SE. ¼, NE. ¼ SW. ¼ and SE. ¼ NW. ¼ sec. 1, containing 1.95 acres; NE. ¼ SW. ¼ sec. 1, T. 49 N., R. 10 W., N. M. P. M., containing 1.95 acres; also portion of NE. ¼ SW. ¼ sec. 1, containing 0.29 acre.	475.00	Jan. 4, 1916
Hubbard, Seph	Portion of E. ½ NE. ¼ NE. ¼ sec. 13, T. 50 N., R. 11 W., N. M. P. M., containing 1.91 acres.	1.00	July 31, 1915
Ironstone Ditch Co	Ironstone Canal System	1.00	Aug. 2, 1915
Ironstone Extension Ditch Co.	Ironstone Extension Canal System	1.00	Do.
Johnson, Gustaf	Portion of NE. ¼ SE. ¼ sec. 21, T. 50 N., R. 10 W., N. M. P. M., containing 3.09 acres.	1.00	July 1, 1915
Jones, Z. I	Portion of W. ½ SE. ¼ SW. ¼ sec. 8, T. 50 N., R. 10 W., N. M. P. M., containing 0.41 acre.	1.00	July 27, 1915
Keller, Emily	Portion of W. ½ NW. ¼ NE. ¼ sec. 17, T. 50 N., R. 10 W., N. M. P. M., containing 1.17 acres.	120.00	Feb. 19, 1916
Killian, B. D	Government road across NE. ¼ SW. ¼ sec. 29, T. 49 N., R. 7 W., N. M. P. M.	1.00	Nov. 15, 1915
Kyle, Julia, et al	Portion of N. ½ SE. ¼, S. ½ NE. ¼ sec. 16, T. 49 N., R. 10 W., N. M. P. M., containing 3.35 acres.	70.00	Do.
Loper, Isaac N	Portion of N. ½ SW. ¼, NW. ¼ SE. ¼ sec. 27, T. 50 N., R. 10 W., N. M. P. M., containing 6.14 acres more or less; also portion of NW. ¼ SE. ¼, sec. 27, containing 6.33 acres.	650.00	Jan. 3, 1916
Martin, I. A	Portion of SW. ¼ NW. ¼ sec. 9, T. 50 N., R. 10 W., N. M. P. M., containing 0.21 acre.	1.00	Oct. 27, 1915
Maxwell, W. G	Portion of SW. ¼ SW. ¼ sec. 8, T. 50 N., R. 10 W., N. M. P. M., containing 2.01 acres.	1.00	July 1, 1915
Meldrum, M. A	Portion of SW. ¼ NW. ¼ sec. 18, T. 50 N., R. 10 W., N. M. P. M., containing 2.42 acres.	1.00	July 31, 1915
Miller, Frederick	Right of way telephone line and wagon road across SE. ¼ SE. ¼ sec. 19; E. ½ NE. ¼ sec. 30, T. 49 N., R. 7 W., N. M. P. M.	1.00	Jan. 22, 1915
McClurg, Lucy I	Portion of E. ½ SE. ¼ SE. ¼ sec. 8, T. 50 N., R. 10 W., N. M. P. M., containing 1.52 acres.	100.00	Apr. 12, 1916
Oliver, A. J	Government road across NE. ¼ NE. ¼, S. ½ NE. ¼, NW. ¼ SE. ¼ sec. 29, T. 49, R. 7 W., N. M. P. M.	1.00	Jan. 6, 1916
Quinlan, F. B	Portion of W. ½ NW. ¼, NE. ¼ NW. ¼ sec. 16, T. 50, R. 10 W., N. M. P. M., containing 0.4 acre.	1.00	July 1, 1915
Ratcliff, A. G	Portion of NE. ¼ NE. ¼ sec. 12, T. 49 N., R. 10 W., NW. ¼ NW. ¼ sec. 7, T. 49 N., R. 9 W., N. M. P. M., containing 1.18 acres.	175.00	Nov. 15, 1915
Rickelton, Anderson	SW. ¼ NW. ¼ sec. 9, T. 50 N., R. 10 W., N. M. P. M., containing 0.15 acre.	1.00	Oct. 27, 1915
Smith, G. M., et al	Portion of SW. ¼ SW. ¼ sec. 2, T. 50 N., R. 11 W., N. M. P. M., containing 2.06 acres.	125.00	Apr. 17, 1915
Smith, Charles Rodney	Portion of N. ½ SW. ¼, NE. ¼ NW. ¼ sec. 16, T. 50 N., R. 10 W., N. M. P. M., containing 0.20 acre.	1.00	Aug. 7, 1915
St. James, Anna B	Portion of SW. ¼ NW. ¼ sec. 6, T. 49 N., R. 9 W., N. M. P. M., containing 0.12 acre.	100.00	Feb. 19, 1916
Telco Investment Co	Portion of NW. ¼ NW. ¼ sec. 1, T. 49 N., R. 10 W., N. M. P. M., containing 0.67 acre.	1.00	June 7, 1915
Walther, Herman	Portion of NE. ¼ SE. ¼ sec. 19, T. 51 N., R. 10 W., N. M. P. M., containing 0.37 acre.	1.00	Apr. 7, 1916
Walstrom, Oscar, et al	Portion of NE. ¼ SE. ¼ sec. 31, T. 51 N., R. 10 W., N. M. P. M., containing 1.58 acres.	270.00	Apr. 22, 1916
Wishart, James W	Portion of SW. ¼ NW. ¼ sec. 27, T. 50 N., R. 10 W., N. M. P. M., containing 2.15 acres.	125.00	Jan. 8, 1916
Young, Elmer E	Portion of W. ½ SW. ¼ sec. 9, T. 50 N., R. 10 W., N. M. P. M., containing 1.23 acres.	1.00	Aug. 11, 1915

Purchases of rights and property—Continued.

IDAHO, BOISE PROJECT.

Vendor.	Description.	Consideration.	Date of deed.
Alt, George L	SW. ¼ SW. ¼ sec. 6, T. 3 N., R. 2 W., containing 0.96 acre.	$1.00	Mar. 19, 1915
Anson, Fred B	Construction of bridge in lieu of right of way; estimated cost.	125.00	June 23, 1916
Asselin, Damase	....do	125.00	Do.
Bennett, W. A	N. ½ SE. ¼ SE. ¼, sec. 6, T. 3 N., R. 1 W., containing 1.82 acres.	1.00	Oct. 19, 1915
Benson, F. A	SE. ¼ SW. ¼ and SW. ¼ SE. ¼ sec. 6, T. 3 N., R. 2 W., containing 4.03 acres.	1.00	Aug. 23, 1915
Bird, A. C	Material for construction of bridge in lieu of right of way; estimated cost.	85.00	May 5, 1916
Boise Lumber Co. and Page & Mott Lumber.	Purchase of old water right of 200 second-feet	20,000.00	Apr. 26, 1915
Canyon County	SE. ¼ NW. ¼ sec. 24, T. 4 N., R. 3 W., containing 0.80 acre.	1.00	May 13, 1915
Cavin, A. D	SW. ¼ SE. ¼ sec. 34, T. 4 N., R. 1 W., containing 2.27 acres.	1.00	Jan. 26, 1916
Christensen, M. M	Material for construction of bridge in lieu of right of way.	85.00	Apr. 6, 1916
Collop, Peter J	NW. ¼ SE. ¼ SW. ¼ sec. 28, T. 4 N., R. 3 W., containing 0.20 acre.	1.00	Dec. 14, 1915
Colwell, Cora M	NW. ¼ SE. ¼ SW. ¼ sec. 28, T. 4 N., R. 3 W., containing 1.21 acres.	151.00	Jan. 20, 1916
Cook, Marion H	Damage to improvements, farm unit D, S. ½ NE. ¼ sec. 28, T. 4 N., R. 4 W.	71.50	Aug. 2, 1915
Cook, Ira C	Lot 1 sec. 19, T. 4 N., R. 2 W., containing 0.84 acre.	1.00	Nov. 24, 1915
Cox, Fannie, Heirs of	NW. ¼ sec. 29, T. 4 N., R. 3 W., containing 8.70 acres.	1.00	Apr. 5, 1916
Culver, Rhoda L	NW. ¼ sec. 30, T. 4 N., R. 3 W., containing 5.24 acres.	1.00	Dec. 13, 1915
Culver, Warren C	NE. ¼ NW. ¼ sec. 30, T. 4 N., R. 3 W., containing 1.81 acres.	1.00	Nov. 13, 1915
Day, H. H. and Frank	Construction of bridge in lieu of right of way	125.00	June 23, 1916
Drake, Wm. P	S. ½ SE. ¼, sec. 35, T. 4 N., R. 1 W., containing 3.54 acres.	1.00	Jan. 31, 1916
Edison, Zed	Construction of bridge in lieu of right of way	110.00	Nov. 12, 1915
Fichtner, August	NE. ¼ NE ¼ sec. 36, T. 4 N., R. 2 W., containing 3.65 acres.	730.00	Mar. 1, 1916
Fenrich, G. M	Damage to improvements, farm unit E, NW. ¼ SW. ¼, SW. ¼ NW. ¼, sec. 28, T. 4 N., R. 5 W.	30.00	June 22, 1915
Franklin, Geo	Construction of bridge in lieu of right of way	125.00	May 5, 1916
Freeman, Edward	....do	125.00	May 4, 1916
Frost, Houston	E. ½ NE. ¼ sec. 29 and N. ½ sec. 28, T. 4 N., R. 3 W., containing 14.37 acres.	1.00	Jan. 20, 1916
Fuss, John N	NW. ¼ SW. ¼ sec. 6, T. 3 N., R. 2 W., containing 0.40 acre.	1.00	Mar. 18, 1915
Gartman, Thomas	Lot 2, sec. 28, T. 3 N., R. 2 W., containing 0.76 acre.	1.00	Mar. 26, 1915
Gordon, Laura T	Material for bridge for landlocked farm	110.00	July 6, 1915
Gray, D. W	SW. ¼ SW. ¼ sec. 36, T. 4 N., R. 2 W., containing 2.31 acres.	1.00	Nov. 20, 1915
Green, R. E	Damage to improvements; break in main canal.	9.10	June 1, 1915
Hall, William A., and George Murray.	S. ½ NE. ¼ sec. 20, T. 4 N., R. 2 W., containing 6.58 acres.	1.00	Nov. 24, 1915
Halton, Fannie	S. ½ S. ½ sec. 26 and N. ½ N. ½ sec. 35, T. 4 N., R. 2 W., containing 16.09 acres.	1.00	Jan. 8, 1916
Hammond, H. G	Damage to improvements W. ½ SE. ¼ NW. ¼ and SW. ¼ NW. ¼ sec. 33, T. 4 N., R. 5 W.	75.00	July 13, 1915
Hasbrouck, J. J	Construction of bridge in lieu of right of way	125.00	May 4, 1916
Hay, J. T	W. ½ SW. ¼, sec. 6, T. 3 N., R. 2 W., containing 1.33 acres.	1.00	Mar. 29, 1915
Hiatt, Carl E	SW. ¼ SE. ¼, sec. 16, T. 3 N., R. 2 W., containing 0.09 acre.	1.00	Aug. 19, 1915
Hilty, John A	N. ½ SW. ¼, sec. 21, T. 3 N., R. 2 W., containing 5.03 acres.	251.50	May 25, 1914
Holman, D. W	SE. ¼ SW. ¼, sec. 35, T. 4 N., R. 1 W., containing 4.66 acres.	466.00	Feb. 17, 1916
Irvin, Henry F	SW. ¼ SE. ¼, sec. 2, T. 3 N., R. 1 W., containing 1.93 acres.	1.00	Feb. 3, 1916
Jones, Chas. E	SE. ¼ SE. ¼, sec. 23, T. 4 N., R. 4 W., containing 3.05 acres.	1.00	Oct. 30, 1915
Kennedy, S. L	Construction of bridge in lieu of right of way	125.00	May 4, 1916
Kernohan, F. H	SW. ¼ SE. ¼ sec. 16, T. 3 N., R. 2 W., containing 0.34 acre.	1.00	Aug. 6, 1915
King, Mrs., and Sherman Tuttle.	Damage to improvements, break in Main Canal.	4.00	June 1, 1915

Purchases of rights and property—Continued.

IDAHO, BOISE PROJECT—Continued.

Vendor.	Description.	Consideration.	Date of deed.
Knight, Sid	NE. ¼ SW. ¼ sec. 16, T. 3 N., R. 2 W., containing 0.96 acre.	$1.00	Aug. 25, 1915
Leslie, H. R	SW. ¼ SE. ¼ sec. 16, T. 3 N., R. 2 W., containing 0.33 acre.	1.00	Aug. 7, 1915
Lohrman, Wm	Damage to improvements, farm unit B, W. ½ NE. ¼ sec. 28, T. 4 N., R. 5 W.	260.00	June 22, 1915
Madden, R. S., and O. V. Badley.	Construction of bridge in lieu of right of way	125.00	Nov. 12, 1915
Maher, William S	Damage to improvements, farm unit E, E. ½ SE. ¼ sec. 34, T. 4 N., R. 5 W.	100.00	Aug. 23, 1915
Mabee, J. H	NW. ¼ NE. ¼ sec. 30, T. 4 N., R. 3 W., containing 3.65 acres.	150.00	Jan. 29, 1916
McCormick, William E	S. ½ NW. ¼, sec. 35, T. 4 N., R. 2 W., containing 0.75 acre.	1.00	Nov. 15, 1915
McElroy, Hugh E	NE. ¼ NE. ¼ sec. 2, T. 3 N., R. 1 W., containing 1.96 acres.	1.00	Mar. 20, 1916
McHose, Harry W	Construction of bridge in lieu of right of way	125.00	June 23, 1916
McMichael, C. K	do	125.00	Dec. 10, 1915
Miller, Ira	S. ½ sec. 27, T. 4 N., R. 2 W., containing 11.18 acres.	1.00	Apr. 1, 1916
Miller, Joseph A	SW. ¼ SW. ¼ sec. 6, T. 3 N., R. 2 W., containing 1.69 acres.	1.00	Mar. 29, 1915
Morrow, Sarah E	S. ½ NE. ¼ sec. 30, T. 4 N., R. 3 W., containing 6.03 acres.	1.00	Oct. 30, 1915
Murray, George	SE. ¼ NW. ¼ sec. 20, T. 4 N., R. 2 W., containing 3.48 acres.	1.00	Dec. 13, 1915
Mossman, H. H	SW. ¼ NW. ¼ sec. 16, T. 3 N., R. 2 W., containing 0.10 acre.	1.00	Aug. 18, 1915
Nampa Highway District and Independent Highway District.	Construction of bridge across Indian Creek; ½ cost of bridge.	477.02	May. 29, 1915
Nelson, Solomon H	W. ½ NW. ¼ sec. 10, T. 3 N., R. 1 W., containing 5.48 acres.	300.00	Oct. 19, 1915
Nelson, James C	Settlement for waste water right destroyed by drain.	1,612.50	Mar. 27, 1916
Nicholas, John M	Construction of bridge in lieu of right of way	125.00	Dec. 10, 1915
Niday, J. L., and S. Richardson.	Damage to improvements, lots 5 and 6, sec. 36, T. 3 N., R. 2 W.	17.50	June 1, 1915
Noble, Anna	Damage to improvements, break in main canal.	40.00	Do.
Packer, E. G	Construction of bridge in lieu of right of way	110.00	July 26, 1915
Parker, Frank	SW. ¼ NE. ¼ SW. ¼ sec. 28, T. 4 N., R. 3 W., containing 1.33 acres.	1.00	Nov. 27, 1915
Peacock, H. R	Damage to improvements, break in main canal.	2.00	June 1, 1915
Pearson, E. G	Construction of bridge in lieu of right of way	125.00	May 4, 1916
Picard, Charles O., and Michael A. Roberts.	do	125.00	Do.
Pleasants, W. A	SE. ¼ SE. ¼ sec. 16, T. 3. N., R. 2 W., containing 1.16 acres.	1.00	Sept. 25, 1915
Do	SE. ¼ SE. ¼, sec. 16, T. 3 N., R. 2 W., containing 0.76 acre.	1.00	Do.
Ragon, D. M	NW. ¼ SE. ¼ sec. 34, T. 4 N., R. 1 W., containing 0.76 acre.	38.00	Jan. 26, 1916
Do	S. ½ SE. ¼ sec. 34, T. 4 N., R. 1 W., containing 9.36 acres.	1.00	Sept. 28, 1915
Rasmussen, J. E	W. ½ NE. ¼ sec. 7, T. 3 N., R. 1 W., containing 3.27 acres.	1.00	Jan. 4, 1916
Rupert, Ira D	NW. ¼ NW. ¼ sec. 35, T. 4 N., R. 2 W., containing 2.80 acres.	1.00	Nov. 20, 1915
Sanford, Frank	Construction of bridge in lieu of right of way	125.00	May 4, 1916
Shryack, C. W	SE. ¼ SW. ¼, sec. 25, T. 4 N., R. 2 W., containing 1.05 acres.	1.00	Feb. 29, 1916
Simmons, John M	W. ½ NW. ¼ sec. 29, T. 3 N., R. 1 E., containing 6.07 acres.	1.00	Jan. 22, 1916
Skeen, John B	SE. ¼ NE. ¼ sec. 33, T. 4 N., R. 1 W., containing 2.11 acres.	1.00	Oct. 19, 1915
Smith, John W	W. ½ NE. ¼ sec. 31, T. 4 N., R. 1 W., containing 4.06 acres.	300.00	Do.
Smith, Sarah Ann	NW. ¼ sec. 31, T. 4 N., R. 1 W., containing 7.94 acres.	580.00	Dec. 28, 1915
Springer, George A	Construction of bridge in lieu of right of way	125.00	May 5, 1916
Starr, W. F	Material for bridge in lieu of right of way	125.00	Apr. 6, 1916
Starr, Lewis	SE. ¼ NE. ¼ sec. 11, T. 3 N., R. 1 W., containing 1.87 acres.	1,00	Mar. 3, 1916
Starr, W. F	SW. ¼ SE. ¼ sec. 23, T. 4 N., R. 4 W., containing 1.02 acres.	1.00	Oct. 30, 1915

Purchases of rights and property—Continued.

IDAHO, BOISE PROJECT—Continued.

Vendor.	Description.	Consideration.	Date of contract.
Stephens Orchard Nursery & Co.	Construction of bridge in lieu of right of way	$110.00	July 1, 1915
Vaughan, George H	NE. ¼ NW. ¼ and NE. ¼ NE. ¼, sec. 14, T. 3 N., R. 1 W., containing 7.36 acres.	736.00	Jan. 25, 1916
Waigand, Charles	SE. ¼ NW. ¼ sec. 16, T. 3 N., R. 2 W., containing 0.10 acre.	1.00	Aug. 7, 1915
Do	SE. ¼ NW. ¼ sec. 16, T. 3 N., R. 2 W., containing 0.91 acre.	1.00	Do.
Wallace, H. E	Material for bridge in lieu of right of way	125.00	Apr. 6, 1916
Wescott, Charles	SW. ¼ SE. ¼ sec. 16, T. 3 N., R. 2 W., containing 0.10 acre.	1.00	Aug. 7, 1915
Young, D. L	SE. ¼, sec. 21, T. 4 N., R. 2 W., containing 7.90 acres.	1.00	Dec. 17, 1915
Whitney, J. B	Construction of bridge in lieu of right of way	125.00	Nov. 12, 1915
Young, W. J	Material for bridge in lieu of right of way	110.00	Mar. 25, 1915

IDAHO, MINIDOKA PROJECT.

Vendor.	Description.	Consideration.	Date of deed.
Briggs, James A	Purchase of laterals, farm unit K, sec. 15, T. 9 S., R. 24 E.	$162.00	Mar. 19, 1915
Cole, Wm. B	Improvements on farm unit F, sec. 22, T. 9 S., R. 24 E.	87.25	Do.
Corless, R. E	Improvements on farm unit D, sec. 2, T. 10 S., R. 22 E.	14.70	Mar. 28, 1916
Cullison, Wm	Purchase of laterals, farm unit J, sec. 29, T. 9 S., R. 24 E.	20.00	Feb. 7, 1916
Davidson, Ephrum	Damages to improvements, farm unit E, sec. 15, T. 9 S., R. 24 E.	5.75	Jan. 15, 1915
Denning, Julia A	Improvements on farm unit G, sec. 33, T. 9 S., R. 23 E.	74.75	May 6, 1915
Ellis, Frank M	Purchase of laterals, farm unit J, sec. 23, T. 10 S., R. 23 E.	16.68	Jan. 16, 1915
Eplor, John F	Improvements on farm unit D, sec. 23, T. 9 S., R. 23 E.	7.75	Dec. 31, 1914
Hall, Ada E	Purchase of laterals, farm unit E, sec. 23, T. 10 S., R. 23 E.	16.66	Jan. 16, 1915
Hardin, E. S	Improvements on farm unit A, sec. 25, T. 9 S., R. 23 E.	18.00	Feb. 7, 1916
Haynes, Leonard C	Purchase of lateral, farm unit H, sec. 35, T. 9 S., R. 24 E.	50.00	Mar. 7, 1916
Hopkins, John B	Purchase of laterals, farm unit K, sec. 19, T. 9 S., R. 25 E.	22.80	Aug. 30, 1915
Hruza, James	Improvements on farm unit G, sec. 33, T. 8 S., R. 25 E.	230.00	Sept. 27, 1915
Huggins, Lyman N	Purchase of laterals, farm unit B, sec. 15, T 9 S., R. 24 E.	398.00	Mar. 19, 1915
Johannesen, Matilda	Purchase of lateral, farm unit G, sec. 7, T. 9 S., R. 25 E.	32.20	Feb. 7, 1916
Johnson, Reuben B	Purchase of laterals, farm unit H, sec. 23, T. 10 S., R. 23 E.	16.66	Jan. 16, 1915
Judd, Alfred and Susan P	Substation site—townsite Marshfield, lot 10, block 4.	1.00	Oct. 4, 1915
Kelly, Ira H	Improvements on farm unit F, sec. 29, T. 9 S., R. 24 E.	29.25	Dec. 29, 1914
Kinney, E. S	Damage to mining claims, Lake Walcott Shore.	1,000.00	Feb. 29, 1916
McAllister, Fred	Improvements on farm unit J, sec. 32, T. 8 S., R. 25 E.	150.00	Sept. 27, 1915
Moncur, Reuben	Purchase of lateral, farm unit B, sec. 7, T. 9 S., R. 25 E.	32.20	Feb. 7, 1916
Olsen, Tolger	Purchase of lateral, farm unit C, secs. 17 and 18, T. 10 S., R. 23 E.	100.00	Do.
Owen, Albert J	Purchase of lateral, farm unit A, sec. 7, T. 9 S., R. 25 E.	32.20	Do.
Parker, David F	Purchase of lateral, farm unit P, sec. 18, T. 9 S. R. 25 E.	64.29	Mar. 24, 1916
Raff, Fred E	Improvements on farm unit C, sec. 2, T. 10 S., R. 22 E.	28.95	Feb. 2, 1915
Roy, Robert A	Purchase of laterals, farm unit C, sec. 10, T. 9 S., R. 24 E.	75.00	Mar. 6, 1915
Rush, Wm	Improvements on farm unit E, secs. 18 and 19, T. 9 S., R. 23 E.	12.75	July 26, 1915
Speer, John T	Purchase of laterals, farm unit J, sec. 3, T. 10 S., R. 24 E.	15.00	Feb. 16, 1915

Purchases of rights and property—Co

IDAHO, MINIDOKA PROJECT—Cont

Vendor.	Description.
Vyse, Guy B	Improvements on farm unit K, sec. 32, R. 25 E.
Wagonhoffer, Louis	Purchase of laterals, farm unit G, sec. 3 S., R. 24 E.
Zellor, Jas. A	Purchase of lateral, farm unit C, sec. 4, S., R. 23 E.

MONTANA, FLATHEAD (INDIAN) PR

Connerley, William	Damage to improvements on allotmen 811, S. ½ SE. ¼ sec. 17, T. 22 N., R. 20 V P. M.
Kalispell Lumber Company	Flowage rights, portion lots 1 and 4, sec. 27 N., R. 24 W., M. P. M.
Larose, Antoine, and Mary Ann Larose.	8.85 acres in NE. ¼ NW. ¼, sec. 5, T. 19 19 W., M. P. M.
McGeorge, Margaret	Flowage rights, portion lot 13, sec. 4, T. R. 24 W., M. P.M.
Miller, Anna C., and Harry G.	Flowage rights, portion lot 13, sec. 4, T. R. 24 W., M. P. M.
Paul, Mary	6.68 acres in lot 8, sec. 1, T. 19 N., R. 20 W P. M.
Paul, Moiese, and Mary Paul	4.14 acres in lot 2, sec. 27, T. 20 N., R. 2 M. P. M.

MONTANA, MILK RIVER PROJEC

Akin, Eugene	Easement over land in the S. ½ SE. ¼ sec. 2 ½ NE. ¼, sec. 29, T. 32 N., R. 33 E., M. P.
Blakeman, William	Easement over land S. ½ NE. ¼ sec. 27, S. ½ ¼ sec. 26, T. 32 N., R. 33 E., M. P. M.
Blue, Archibald	Easement over land in SW. ¼ SW. ¼ sec. 3 32 N., R. 34 E., M. P. M.
Breipohl, Herman	Damages to improvements on the S. ½ N sec. 25, T. 32 N., R. 33 E., M. P. M.
Davison, E. H	Damages to property of claimant from f water, Dodson South Canal.
Ereaux, Frank	Damages to crops of claimant on Fort Belk Indian Reservation.
Great Northern Railway Co	5.86 acres of land in N. ½ SE. ¼ sec. 16, T. 30 R. 30 E., M. P. M., and 1.32 acres in the S NE. ¼ sec. 16, T. 30 N., R. 30 E., M. P. M
Hall, Clarence	Purchase of improvements in Lots 1, 2, an and SW. ¼ NE. ¼ sec. 31, T. 29 N., R. 39 M. P. M.
Hawkins, Henry	Easement over land in NE. ¼ NW. ¼ sec. 9 31 N., R. 35 E., M. P. M.
Hedges, H. H	Damages to improvements on the SW. ¼ N ¼ and S. ½ sec. 28, T. 32 N., R. 33 E., M. P.
Kippen, Donald R	Damages to improvements on the SE. ¼ S sec. 25, T. 32 N., R. 33 E., M. P. M.
Milk River Improvement Co	Easement over land in SE. ¼ SE. ¼ sec. 31, a lot 11, sec. 32, T. 31 N., R. 36 E., M. P. M.
Office of Indian Affairs	81 tracts of land aggregating 2,007.76 acres Dodson diversion and 27 tracts aggregat 579.71 acres for Dodson South Canal, F Belknap Indian Reservation.
Scheele, William E	Damages to improvements on the NE. ¼ N ¼ sec. 31, T. 32 N., R. 34 E., M. P. M.
Schulz, Julia	Damages to crops on the Fort Belknap Indi Reservation caused by overflow of Peop Creek.

MONTANA, MILK RIVER PROJECT, ST. MARY ST

LANDS PURCHASED FOR SHERBURNE RESERVO

Blackfeet Indian tribe	Lots 3, 4, and 5, sec. 35, T. 36 N., R. 15 W
Do	Lots 2 and 3, sec. 36, T. 36 N., R. 15 W

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[1] Lands purchased were tribal and allotted lands of the Blackfeet India Reservation have not yet been approved. Transfer was made by approva ment was made Aug. 13, 1915.

Purchases of rights and property—Continued.

MONTANA, MILK RIVER PROJECT, ST. MARY STORAGE UNIT—Continued.

LANDS PURCHASED FOR ST. MARY LAKES RESERVOIR.

Vendor.	Description.	Consideration.	Date of deed.
Blackfeet Indian tribe	Lots 1, 6, 7, and 10, sec. 34, T. 35 N., R. 14 W	$484.27	(1)
Do	Lot 1 (east of river), lot 1 (west of river), and lot 2, sec. 33, T. 35 N., R. 14 W.	103.92	(1)
Do	Lots 6, 9, and 10, sec. 28, T. 35 N., R. 14 W	149.54	(1)
Do	Lots 2, 3, 4, 8, and 9 (east of river and 9 west of river), 13, 14, 18, and 19, sec. 27, T. 35 N., R. 14 W.	834.74	(1)
Do	Lot 2, sec. 23, T. 35 N., R. 14 W	67.78	(1)
Do	Lots 1, 2, 3, 6, 7, 10, 11, and 14, sec. 22, T. 35 N., R. 14 W.	315.47	(1)
Do	Lots 1, 4, 5, and 8, sec. 21, T. 35 N., R. 14 W	66.24	(1)
Do	Lot 2, sec. 16, T. 35 N., R. 14 W	.93	(1)
Do	Lots 1, 4, 5, 8, 11, 12, and 15, sec. 15, T. 35 N., R. 14 W.	236.02	(1)
Do	Lots 4, 5, 8, and 9, sec. 14, T. 35 N., R. 14 W	270.78	(1)
Do	Lots 2, 5, and 6, sec. 11. T. 35 N., R. 14 W	208.10	(1)
Do	Lots 1, 4, 5, 8, 9, 12, 13 and 16, sec. 10, T. 35 N., N. R. 14 W.	453.48	(1)
Do	Lots 5 and 8, sec. 4, T. 35 N., R. 14 W	18.32	(1)
Do	Lots 3, 11, 12, 13, 16, 16, 20, and 21, sec. 3, T. N., R. 14 W.	427.67	(1)
Do	Lots 2, 3, 4, 9, 10, 13, and 14, and NW. ¼ NW. ¼ sec. 34, T. 36 N., R. 14 W.	1,626.85	(1)
Do	Lots 4, 7, 8, and 11, sec. 33, T. 36 N., R. 14 W	260.07	(1)
Do	SE. ¼ SE. ¼ NE. ¼ sec. 28, T. 36 N., R. 14 W	1,000.00	(1)
Do	Lots 1, 2, and 5, and SW. ¼, W. ½, SE. ¼, S. ½ NW. ¼, SW. ¼ NE. ¼ sec. 27, T. 36 N., R. 14 W.	2,663.35	(1)

LANDS PURCHASED FOR ST. MARY CANAL.

Vendor.	Description.	Consideration.	Date of deed.
Blackfeet Indian tribe	SW. ¼, S. ½, S. ½ NW. ¼, SW. ¼ NE. ¼, NE. ¼ NE. ¼ sec. 28, T. 36 N., R. 14 W., 213.9 acres.	$409.80	(1)
Do	N. ½ NW. ¼, NW. ¼ NE. ¼ sec. 27, T. 36 N., R. 14 W.	300.00	(1)
Do	SW. ¼, W. ½ SE. ¼, W. ½ E. ½ SE. ¼, S. ½ NW. ¼, W. ½ NE. ¼ sec. 22, T. 36 N., R. 14 W., 313.8 acres.	470.70	(1)
Do	E. ½ E. ½ SE. ¼, NE. ¼ SE. ¼ SE. ¼ NE. ¼ sec. 21, T. 36 N., R. 14 W., 19.3 acres.	28.95	(1)
Do	E. ½ NE. ¼ sec. 16, T. 36 N., R. 14 W., 14.5 acres.	87.00	(1)
Do	E. ½ E. ½ W. ½ NE. ¼ sec. 9, T. 36 N., R. 14 W., 5.1 acres.	30.60	(1)
Do	E. ½ E. ½ W. ½ SE. ¼, E. ½ NE. ¼ sec. 4, T. 36 N., R. 14 W., 37.8 acres.	50.58	(1)
Do	E. ½, NW. ¼, N. ½ NE. ¼, SW. ¼ sec. 3, T. 36 N., R. 14 W., 266.6 acres.	333.25	(1)
Do	W. ½ W. ½ NW. ¼, W. ½ NW. ¼, SW. ¼ sec. 2, T. 36 N., R. 14 W., 20.5 acres.	25.63	(1)
Do	E. ½ NE. ¼, NE. ¼ sec. 21, T. 36 N., R. 14 W., 8.1 acres.	48.60	(1)
Do	W. ½ W. ½ NW. ¼, NW. ¼ sec. 22, T. 36 N., R. 14 W., 1.8 acres.	10.80	(1)
Do	E. ½ SE. ¼ SE. ¼ sec. 16, T. 36 N., R. 14 W., 6.3 acres.	37.80	(1)
Do	SW. ¼ W. ½ SE. ¼ E. ½ E. ½ SE. ¼ E. ½ E. ½ SE. ¼ SE. ¼ sec. 34, T. 37 N., R. 14 W., 112.7 acres.	250.30	(1)
Do	W. ½ NW. ¼ W. ½ W. ½ NW. ¼ SW. ¼ sec. 35, T. 37 N., R. 14 W., 19.9 acres.	119.40	(1)
Do	S. ½ SW. ¼ sec. 19, T. 37 N., R. 13 W., 15.6 acres.	93.60	(1)
Do	NW. ¼ NE. ¼ NW. ¼ sec. 30. T. 37 N., R. 13 W., 70.3 acres.	421.80	(1)
Do	Lot 2, sec. 21, T. 37 N., R. 13 W., 0.3 acre	2.40	(1)
Do	NW. ¼ SW. ¼ NE. ¼ sec. 22, T. 37 N., R. 13 W., 0.2 acre.	1.20	(1)
Do	W. ½ W. ½ NW. ¼ SE. ¼ sec. 20, T. 37 N., R. 12 W., 0.6 acres.	3.60	(1)
Do	S. ½ SW. ¼ NW. ¼ N. ½ SW. ¼ NE. ¼ sec. 21, T. 37 N., R. 12 W., 1.7 acres.	10.20	(1)
Do	W. ½ NW. ¼ NW. ¼ N. ½ N. ½ N. ½ NW. ¼ sec. 22, T. 37 N., R. 12 W., 3.8 acres.	30.40	(1)

[1] Lands purchased were tribal and allotted lands of the Blackfeet Indians. Allotments on Blackfeet Reservation have not yet been approved. Transfer was made by approval of the Indian Office. Payment was made Aug. 13, 1915.

Purchases of rights and property—Continued.

MONTANA, MILK RIVER PROJECT, ST. MARY STORAGE UNIT—Continued.

LANDS PURCHASED FOR ST. MARY CANAL—Continued.

Vendor.	Description.	Consideration.	Date of deed.
Blackfeet Indian tribe	W. ½ NW. ¼ sec. 19, T. 37 N., R. 12 W., 12.9 acres.	$77.40	(1)
Do	S. ½ SW. ¼ E. ½ NE. ¼ sec. 18, T. 37 N., R. 12 W., 28.6 acres.	171.60	(1)
Do	W. ½ W. ½ W. ½ NW. ¼ sec. 17, T. 37 N., R. 12 W., 4.4 acres.	26.40	(1)
Arnoux, James	SE. ¼ SE. ¼ sec. 7, T. 37 N., R. 12 W., 5.6 acres	56.00	(1)
Bull Child, Joseph	N. ½ SE. ¼ SW. ¼ NW. ¼ E. ½ E. ½ NE. ¼ SW. ¼ sec. 20, T. 37 N., R. 12 W., 1 acre.	8.00	(1)
Cobert, John	E. ½ E. ½ SE. ¼ SE. ¼ N. ½ NE. ¼ SE. ¼ SE. ¼ sec. 14 T. 37 N., R. 13 W.; W ½ SW. ¼ SW. ¼ sec. 13, T. 37 N., R. 13, W., 5.9 acres.	47.20	(1)
De Wolfe, Eva	S. ½ S. ½ NW. ¼ SW. ¼ sec. 21, N. ½ N. ½ NE. ¼ NE. ¼ sec. 22, T. 37 N., R. 13 W., 1.4 acres.	11.20	(1)
De Wolfe, Maggie	SE. ¼ SE. ¼ SE. ¼ SE. ¼ sec. 15, N. ½ N. ½ S. ½ SW. ¼ sec. 14, T. 37 N., R. 13 W., 0.6 acre.	3.60	(1)
Douglas, Arthur	E. ½ SE. ¼ SW. ¼ sec. 6, N. ½ NE. ¼ NW. ¼ NW. ¼ sec. 7, T. 37 N., R. 11 W., 2.4 acres.	19.20	(1)
Douglas, James	N. ½ S. ½ SE. ¼ sec. 6, T. 37 N., R. 11 W., 0.9 acre.	7.20	(1)
Douglas, Minnie	W. ½ NW. ¼ SW. ¼ NW. ¼ sec. 7, T. 37 N., R. 11 W., 0.2 acre.	1.60	(1)
Fast Buffalo Horse, Sam	SE. ¼ SE. ¼ SW. ¼ SW. ¼ sec. 15, T. 37 N., R. 12 W., 0.4 acre.	3.20	(1)
Henkel, George	N. ½ SW. ¼ NE. ¼ NE. ¼ sec. 25, E. ½ SE. ¼ SE. ¼ SE. ¼ sec. 24, T. 37 N., R. 14 W., 23.6 acres.	363.80	(1)
Henkel, William	S. ½ SE. ¼ NW. ¼, W. ½ NE. ¼, sec. 25, T. 37 N., R. 14 W., 14.1 acres.	187.80	(1)
Houck, Eleanor	N. ½ SE. ¼ sec. 18, T. 37 N., R. 12 W., 20.8 acres.	204.80	(1)
Kennerly, Perry	E. ½ NE. ¼ sec. 21, T. 37 N., R. 12 W., 4 acres	28.00	(1)
Le Page, Annie	SW. ¼ SW. ¼ SE. ¼ SW. ¼ N. ½ N. ½ N. ½ SE. ¼ sec. 15, T. 37 N., R. 12 W., 1.2 acres.	9.60	(1)
Masterman, Violet	NE. ¼ SE. ¼ NW. ¼ NW. ¼ sec. 14, T. 37 N., R. 12 W., 0.4 acre.	3.20	(1)
Norman, Frank	NW. ¼ SW. ¼ SE. ¼ sec. 18, T. 37 N., R. 12 W., 1.4 acres.	8.40	(1)
Paul, Leona	N. ½ N. ½ NW. ¼ S. ½ NE. ¼ sec. 24, T. 37 N., R. 13 W., 6.4 acres.	51.20	(1)
Peterson, Irvin	NE. ¼ NE. ¼ NE. ¼ NW. ¼, NW. ¼ NW. ¼ NW. ¼ NE. ¼ sec. 14, T. 37 N., R. 12 W., 0.2 acre.	1.60	(1)
Peterson, May	W. ½ SW. ¼ NW. ¼ SW. ¼ sec. 12, T. 37 N., R. 12 W., 0.4 acre.	3.20	(1)
Peterson, Mitchell	SE. ¼ SE. ¼ SE. ¼ SW. ¼, SW. ¼ SW. ¼ SW. ¼ SE. ¼, E. ½ SE. ¼ NE. ¼ SE. ¼ sec. 11, T. 37 N., R. 12 W., 1 acre.	8.00	(1)
Powell, Henry A	SW. ¼ sec. 26, T. 37 N., R. 14 W., 26.1 acres	238.80	(1)
Powell, Jesse	SE. ¼, S. ½ NE. ¼ sec. 26, T. 37 N., R. 14 W., 42.4 acres.	419.20	(1)
Upham, Antonio	N. ½ NE. ¼ NE. ¼ sec. 16, T. 36 N., R. 14 W., 5.2 acres.	81.60	(1)
Upham, Joseph	W. ½ E. ½ SE. ¼, E. ½ W. ½ SE. ¼ NE. ¼, sec. 4, T. 36 N., R. 14 W., 16.3 acres.	180.40	(1)
Upham, William	SE. ¼ and NE. ¼ sec. 9, T. 36 N., R. 14 W., 20.7 acres.	307.00	(1)
Wagner, Edna	SW. ¼ NE. ¼ E. ½ SE. ¼ NE. ¼ sec. 12, T. 37 N., R. 12 W., 6.3 acres.	50.40	(1)
Wagner, William	E. ½ SW. ¼ SE. ¼ NE. ¼ NE. ¼ SE. ¼ sec. 16, NE. ¼ SE. ¼ NE. ¼ sec. 21, T. 36 N., R. 14 W., 13.8 acres.	135.40	(1)

MONTANA, SUN RIVER PROJECT.

Henningsen Land Co	A tract of land containing 1.16 acres, more or less, lying and being in the NW. ¼ SW. ¼ sec. 9, T. 22 N., R. 7 W. M. P. M., as shown on blue print S-5582.	$50.00	Sept. 2, 1915

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[1] Lands purchased were tribal and allotted lands of the Blackfeet Indians. Allotments on Blackfeet Reservation have not yet been approved. Transfer was made by approval of the Indian Office. Payment was made Aug. 13, 1915.

Purchases of rights and property—Continued.

MONTANA-NORTH DAKOTA, LOWER YELLOWSTONE PROJECT.

Vendor.	Description.	Consideration.	Date of deed.
Obergfell, Charles, et al	0.48 acre of land in sec. 33, T. 23 N., R. 59 E., M. P. M.	$167.00	May 22, 1913 Oct. 7, 1914
Rood, Bertha A., and husband	11.5 acres in sec. 2, T. 23 N., R. 59 E., M. P. M.	70.00	June 29, 1915
State of Montana	1.79 acres in sec. 36, T. 24 N., R. 59 E., M. P. M.	1.00	Nov. 30, 1915

NEBRASKA-WYOMING, NORTH PLATTE PROJECT.

Grover, Merl O., and wife	Right of way for Lake Alice across NE. ¼ NE. ¼ sec. 8, T. 23 N., R. 54 W., sixth P. M.	$1.00	Apr. 7, 1916

NEW MEXICO, CARLSBAD PROJECT.

The Pecos Valley Trust Co.	Lots 2, 4, 6, 8, 10, block 9, town site of Otis, in NE. ¼ NE. ¼ sec. 34, T. 22 S., R. 27 E., Eddy County, N. Mex.	$150.00	Feb. 4, 1916

OREGON, UMATILLA PROJECT.

Dodd, Elmer P.	Improvements on strip of land 900 feet long in NW. ¼ sec. 14, T. 4 N., R. 28 E., W. M.	$115.00[a]	Mar. 24, 1915
Maxwell Land & Irrigation Co.	Right of way over portion of W. ½ sec. 4, and E. ½ and SW. ¼ sec. 5, T. 4 N., R. 29 E., W. M.	1.00	Dec. 4, 1915

OREGON-CALIFORNIA, KLAMATH PROJECT.

Adamek, Frank, et ux	Part NW. ¼ NW. ¼ sec. 17, T. 41 S., R. 12 E., W. M.	$1.00	June 14, 1916
Adams, J. Frank, et ux	Part N. ½ SW. ¼, SE. ¼ SW. ¼, sec. 11, T. 41 S., R. 11 E., W. M.	1.00	June 5, 1916
Anderson, Otto F	Part SE. ¼ NW. ¼ sec. 32, T. 39 S., R. 9 E., W. M.	1.00	Dec. 28, 1915
Bradbury, Clement, et al	Part Lot 6, sec. 29, lot 1, sec. 32, T. 39 S., R. 10 E. W. M.	50.00	Nov. 16, 1915
Briggs, Stuart C	Part NW. ¼ NE. ¼ sec. 29, T. 39 S., R. 9 E., W. M.	50.00	Feb. 19, 1916
Chapman, N. J	Part SW. ¼ SE. ¼ sec. 10, part NW. ¼ NE. ¼ sec. 15, T. 39 S., R. 9 E., W. M.	1.00	Nov. 8, 1915
Cozad, C. B., et ux	Part NE. ¼ NE. ¼ sec. 6, T. 40 S., R. 10 E., W. M.	100.00	Oct. 12, 1915
Craven, O. D., et al	Part SW. ¼ NE. ¼, NW. ¼ SE. ¼, sec. 21, T. 39 S., R. 9 E., W. M.	1.00	Dec. 10, 1915
Dixon, J. R., et ux	Part NE. ¼ NE. ¼ sec. 26, T. 39 S., R. 9 E., W. M.	1.00	May 25, 1916
Drazil, Vaclav, et ux	Part NW. ¼ SE. ¼ sec. 8, T. 41 S., R. 12 E., W. M.	1.00	June 14, 1916
Eastwood, Simeon C., et ux	Part lots 8 and 9, sec. 17, T. 40 S., R. 10 E., W. M.	136.50	Nov. 30, 1915
Ezell, J. M., et ux	Part S. ½ SW. ¼ sec. 11, T. 39 S., R. 9 E., W. M.	1.00	Apr. 25, 1916
Ezell, W. C., et ux	Part NE. ¼ SE. ¼, E. ½ NE. ¼, sec. 10, T. 39 S., R. 9 E., W. M.	1.00	Nov. 11, 1915
Geertson, L. F., et ux	Part lots 8 and 11, sec. 21, lot 6, sec. 17, T. 40 S., R. 10 E., W. M.	400.00	Oct. 20, 1915
Glenn, Ophelia, et vir	Part lot 3, sec. 8; lot 10, sec. 17, T. 40 S., R. 10 E., W. M.	130.00	Nov. 1, 1915
Griffith, J. B., et ux	Part lot 11; SE. ¼ NE. ¼, sec. 31, T. 39 S., R. 10 E., W. M.	275.00	Oct. 18, 1915
Halousek, Ella, et vir	Part NW. ¼ SE. ¼, sec. 16, T. 41 S., R. 12 E., W. M.	1.00	June 14, 1916
Hanel, Lewis, et ux	Part SE. ¼ SE. ¼, sec. 15, T. 41 S., R. 12 E., W. M.	1.00	Do.
Hanel, Lewis, et ux	Part E. ½ SE. ¼, sec. 15, T. 41 S., R. 12 E., W. M.	1.00	June 13, 1916
Havlina, James, et ux	Part SW. ¼ NW. ¼; NW. ¼ SW. ¼, sec. 9, T. 41 S., R. 12 E., W. M.	1.00	June 7, 1916
Hawkins, Martha A. and E. A.	Part W. ½ SW. ¼, sec. 20, T. 39 S., R. 10 E., W. M.	1.00	May 25, 1916
Hill, William F., et ux	Part NE. ¼ NE. ¼, sec. 35, T. 40 S., R. 10 E., W. M.	26.00	Nov. 2, 1915
Honzik, John, et ux	Part NW. ¼ NW. ¼, sec. 16, T. 41 S., R. 12 E., W. M.	1.00	June 13, 1916
Idler, Gottlob W	Part SE. ¼ NE. ¼, sec. 26, T. 39 S., R. 9 E. W. M.	133.20	July 27, 1915

OREGON-CALIFORNIA, KLAMATH PROJECT—Continued.

Vendor.	Description.	Consideration.	Date of deed.
Jelinek, Vincent, et ux	Part NE. ¼ NE. ¼, sec. 18, T. 41 S., R. 12 E., W. M.	$1.00	June 14, 1916
Johns, Albert, et ux	Part NE. ¼ NW. ¼, sec. 23, T. 39 S., R. 9 E., W. M.	40.00	Jan. 31, 1916
Johnson, J. M., et ux	Part NE. ¼ SW. ¼, sec. 15, T. 41 S., R. 12 E., W. M.	1.00	June 13, 1916
Lahoda, E. J., et ux	Part SW. ¼ NW. ¼, sec. 16, T. 41 S., R. 12 E., W. M.	1.00	June 14, 1916
Lewis, C. C., et ux	Part NE. ¼ SW. ¼, sec. 15, T. 41 S., R. 12 E., W. M.	1.00	June 28, 1915
Maddox, J. A	Part lot 4, sec. 21; S. ½ SW. ¼, sec. 22; NE. ¼ NW. ¼; SW. ¼ NE. ¼, sec. 27, T. 40 S., R. 10 E., W. M.	270.00	Oct. 6, 1915
Malone, Robt. L., et ux	Part W. ½ NE. ¼, SE. ¼ NW. ¼, sec. 19, T. 41 S., R. 14 E., W. M.	1.00	Dec. 6, 1915
Mason, Mae C., et vir	Part SW. ¼ SE. ¼, sec. 20, T. 39 S., R. 9 E., W. M.	1.00	Oct. 14, 1915
Melhase, Fred, et al	Part lots 6 and 7, sec. 17, T. 40 S., R. 10 E., W. M.	50.00	Oct. 20, 1915
Micka, Joseph, et ux	Part SE. ¼ NW. ¼, sec. 8, T. 41 S., R. 12 E., W. M.	1.00	June 13, 1916
Miller, Robt. A	Part lots 1 and 2, sec. 23, T. 39 S., R. 9 E., W. M.	265.00	Aug. 10, 1915
Moore, John M., et ux	Part SE. ¼ SE. ¼, sec. 22; SW. ¼ SW. ¼, sec. 23, T. 39 S., R. 9 E., W. M.	1.00	Nov. 15, 1915
Moore, Mary L	Part S. ½ SW. ¼, sec. 26, T. 39 S., R. 9 E., W. M.	1.00	Nov. 23, 1915
Morgan, John D., et ux	Part NW. ¼ NE. ¼, sec. 31, T. 39 S., R. 9 E., W. M.	1.00	Dec. 28, 1915
Murphy, M., et ux	Part NW. ¼ NE. ¼, sec. 35, T. 39 S., R. 9 E., W. M.	1.00	Nov. 12, 1915
Newton, H. S., et ux	Part SE. ¼ SW. ¼, sec. 19, T. 39 S., R. 10 E., W. M.	1.00	May 25, 1916
Nylander, Hans, et ux	Part SW. ¼ NE. ¼; NW. ¼ SE. ¼, sec. 8, T. 40 S., R. 10 E., W. M.	120.00	Oct. 26, 1915
Obenchain, Silas, et ux	Part N. ½ SE. ¼, sec. 19, T. 39 S., R. 9 E. W. M.	1.00	June 22, 1916
Otoman, Joseph, et ux	Part SW. ¼ NE. ¼, sec. 8, T. 41 S., R. 12 E., W. M.	1.00	June 14, 1916
Parrish, Ella B., et al	Part SW. ¼ SW. ¼, sec. 16, T. 40 S., R. 10 E., W. M.	7.00	Nov. 2, 1915
Patterson, Warren, et ux	Part SE. ¼ NE. ¼, sec. 26, T. 39 S., R. 9 E., W. M.	1.00	May 25, 1916
Petrasek, Anton, et ux	Part SE. ¼ SW. ¼, sec. 15, T. 41 S., R. 12 E., W. M.	1.00	June 14, 1916
Pettit, Herman C., et ux	Part NW. ¼ SW. ¼, sec. 26, T. 40 S., R. 10 E., W. M.	28.50	Nov. 11, 1915
Pospisil, J. F., et ux	Part NE. ¼ SW. ¼, sec. 8, T. 41 S., R. 12 E., W. M.	1.00	June 13, 1916
Potucek, Joe, et ux	Part NW. ¼ NE. ¼, sec. 17, T. 41 S., R. 12 E., W. M.	1.00	Do.
Robustellini, Joe	Part NE. ¼ NW. ¼, sec. 35, T. 39 S., R. 9 E., W. M.	1.00	Nov. 12, 1915
Shive, W. T., et ux	Part SE. ¼, SW. ¼, sec. 29, T. 39 S., R. 9 E., W. M.	1.00	June 27, 1916
Short, R. C., et ux	Part NE. ¼ SW. ¼, sec. 19, T. 39 S., R. 10 E., W. M.	1.00	May 25, 1916
Smidl, Joe	Part SE. ¼ NE. ¼, sec. 8, T. 41 S., R. 12 E., W. M.	1.00	June 14, 1916
Tingley, W. L., et ux	Part NW. ¼ NE. ¼; NE. ¼ NW. ¼, sec. 32, T. 39 S., R. 9 E., W. M.	1.00	Dec. 28, 1915
Vavricka, Karel, et ux	Part SW. ¼ SW. ¼, sec. 9, T. 41 S., R. 12 E., W. M.	1.00	June 13, 1916
Vavricka, Karel, et ux	Part SW. ¼ NE. ¼, sec. 17, T. 41 S., R. 12 E., W. M.	1.00	June 14, 1916
White, G. W., et al	Part SW. ¼ NE. ¼; NW. ¼ SE. ¼, sec. 29, T. 39 S., R. 9 E., W. M.	182.50	Feb. 19, 1916
Worden, Chas. E., et ux	Part lots 6, 11, and 12, sec. 20, T. 39 S., R. 9 E., W. M.	1.00	Oct. 14, 1915
Zumpfe, Marie, et vir	Part SE. ¼ SE. ¼, sec. 8, T. 41 S., R. 12 E., W. M.	1.00	June 14, 1916

UTAH, STRAWBERRY VALLEY PROJECT.

Ahlin, Elmira, administratrix of estate.	4.83 acres in secs. 31 and 36, T. 9 S., R. 1 and 2 E., S. L. B. and M.	$550.00	Nov. 23, 1915
Barnett, William E	12.23 acres in secs. 29 and 31, T. 9 S., R. 2 E., S. L. B. and M.	425.00	Mar. 15, 1915
Cushing, Rena G	0.164 acre in sec. 36, T. 9 S., R. 1 E., S. L. B. and M.	50.00	Oct. 13, 1915
Greenhalgh, Emma C	2 tracts, 0.39 acre in NW. ¼ NW. ¼, sec. 36, and 1.5 acres in NE. ¼ NE. ¼, sec. 35, T. 9 S., R. 1 E., S. L. B. and M.	175.00	June 25, 1915

Purchases of rights and property—Continued.

UTAH, STRAWBERRY VALLEY PROJECT—Continued.

Vendor.	Description.	Consideration.	Date of deed.
Moore, Clara Huish	0.91 acre in NE. ¼ NW. ¼, sec. 21, T. 9 S., R. 2 E., S. L. B. and M.	$50.00	Nov. 1, 1915
Olsen, Hyrum	0.25 acre in N. ½ SW. ¼ SW. ¼, sec. 25, T. 9 S., R. 1 E., S. L. B. and M.	50.00	Nov. 9, 1915
Page, Jonathan S., jr	0.352 acre in SE. ¼ SW. ¼, sec. 16, T. 9 S., R. 2 E., S. L. B. and M.	25.00	Dec. 9, 1915
Stevens, Ed. E., and Mary E.	0.152 acre in NW. ¼ NW. ¼, sec. 21, T. 9 S., R. 2 E., S. L. B. and M.	25.00	Nov. 3, 1915
Webb, James H	1.56 acres in N. ½ S. ½ SE. ¼, sec. 14, T. 9 S., R. 1 E., S. L. B. and M.	76.50	June 26, 1915

WASHINGTON, YAKIMA PROJECT, STORAGE UNIT.

Vendor.	Description.	Consideration.	Date of deed.
Troupe, Frank	Purchase of land in sec. 2, T. 20 N., R. 13 E., W. M.	$169.50	Jan. 13, 1916

WYOMING, SHOSHONE PROJECT.

Vendor.	Description.	Consideration.	Date of deed.
Ward, John, and Evelyn	E. ½ SE. ¼, sec. 24, T. 52 N., R. 103 W.; also W. ½ SW. ¼, sec. 19, T. 52 N., R. 102 W.	$10,132.00	July 19, 1915

PRINCIPAL CURRENT CONTRACTS.

In the following tables are shown, by projects, data relative to the principal contracts in operation or completed during the fiscal year ending June 30, 1916:

Principal current contracts.

ARIZONA, SALT RIVER PROJECT.

No.	Date.	Contractor.	Description.	Estimated value.	Estimated earnings, June 30, 1916.	Completion due.
546	Aug. 7, 1914	General Electric Co.	Generator for power plant.	$21,694.00	[1] $22,368.25	Sept. 29, 1915
582	Sept. 25, 1914	S. J. Rhodes	Earthwork and structures, Wallace feeder.	14,132.25	[1] 14,423.20	Jan. 18, 1915
	Feb. 25, 1915	Baker Iron Works	Gates	2,411.00	[1] 2,487.55	Apr. 1, 1915
	Mar. 4, 1915	Advance Mach. Co.	Gates	539.88	[1] 529.88	Mar. 15, 1915
637	June 7, 1915	Rosedale Foundry & Machine Co.	Two needle valve outlets for sluicing tunnel.	6,240.00	[1] 6,240.00	Oct. 21, 1915

ARIZONA-CALIFORNIA, YUMA PROJECT.

No.	Date.	Contractor.	Description.	Estimated value.	Estimated earnings, June 30, 1916.	Completion due.
687	Mar. 27, 1916	Bucyrus Co	Dragline excavator	$14,500.00	....	July 25, 1916

CALIFORNIA, ORLAND PROJECT.

No.	Date.	Contractor.	Description.	Estimated value.	Estimated earnings, June 30, 1916.	Completion due.
	May 16, 1916	Orland Unit Water Users' Association.	Completion of rockfill, South Canal diversion weir.	$3,000.00	....	Sept. 15, 1916

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[1] Completed.

COLORADO, GRAND VALLEY PROJECT.

No.	Date.	Contractor.	Description.	Estimated value.	Estimated earnings, June 30, 1915.	Completion due.
557	July 6, 1914	Winston Bros. Co.	Main Canal	$384,264.50	$368,900.82	Sept. 1, 1915
628	Apr. 1, 1915	Reynolds-Ely Construction Co.	Main Canal, division 4, schedules 1 and 4.	38,675.00	[1] 40,539.07	Sept. 16, 1915
630	Apr. 3, 1915	Mendenhall, Straw & Bird Co.	Main Canal, division 4, schedules 2, 3, 5, 6, 7.	59,921.00	[1] 56,531.51	Sept. 21, 1915
	July 15, 1915	Arthur Malcolm	Schedule 1, laterals	1,140.00	[1] 1,175.40	Dec. 1, 1915
	July 15, 1915	Wilbur Malcolm	Schedule 2, laterals	572.00	[1] 616.44	Do.
	July 15, 1915	George Bell	Schedule 3, laterals	977.10	[1] 946.24	Do.
	July 6, 1915	John E. Nelson	Schedule 4, laterals	654.60	[1] 533.07	Do.
	July 9, 1915	O'Bryan & Miles	Schedule 5, laterals	718.00	[1] 588.45	Do.
	July 17, 1915	Dennis Palfreyman	Schedule 6, laterals	1,020.00	[1] 1,083.01	Do.
	July 17, 1915	Jess Palfreyman	Schedule 7, laterals	1,020.00	[1] 792.84	Do.
668	Nov. 30, 1915	Sam Kloczko	Schedule 11, laterals	1,649.00	952.60	July 30, 1916
669	Nov. 30, 1915	James O'Bryan	Schedule 13, laterals	2,364.50	2,165.86	Do.
670	Nov. 26, 1915	Lakeside Bridge & Steel Co.	Chains and shafts	5,147.00	1,200.00	Feb. 20, 1916
671	Dec. 3, 1915	Reynolds-Ely Construction Co.	Sta. 2437–3100, Main Canal, division 4.	28,584.00	[1] 34,307.24	June 30, 1916
673	Nov. 30, 1915	Chas. E. Lutz	Schedule 16, laterals	1,578.00	[1] 1,268.76	Do.
675	Dec. 6, 1915	Kirkendall & Nelson.	Schedule 10, laterals	2,801.80	1,953.20	July 30, 1916
676	Dec. 11, 1915	J. W. Collier	Schedule 14, laterals	1,323.00	1,328.04	Do.
678	Dec. 6, 1915	J. M. Groesbeck	Schedule 12, laterals	2,937.50	[1] 2,742.27	June 30, 1916
680	Dec. 20, 1915	Wilson, Hicks & Wilson.	Schedule 9, laterals	3,323.50	[1] 3,534.87	Do.
	Dec. 23, 1915	Westinghouse Electric & Manufacturing Co.	Gasoline engine, generator, and motors.	4,114.00	....	
	Dec. 27, 1915	Electric Storage Battery Co.	Storage batteries	1,304.00	[1] 1,304.00	Feb. 21, 1916
	Dec. 23, 1915	General Electric Co.	Motor and switchboard.	270.00	[1] 270.00	
703	June 22, 1916	Pacific Tank & Pipe Co.	Wood-stave pipe	21,157.00	....	Oct. 15, 1916

COLORADO, UNCOMPAHGRE VALLEY PROJECT.

	Sept. 22, 1915	Orman Construction Co.	North mesa lateral extension siphon.	$449.50	[1] $584.46	Nov. 9, 1915
	Nov. 6, 1915	J. D. Brock and F. E. Wiggins.	Boomer feeder ditch	564.00	[1] 462.25	Mar. 15, 1916
	Nov. 10, 1915	Pacific Tank & Pipe Co.	Metal-banded redwood-stave pipe.	1,233.00	[1] 1,233.00	Dec. 1, 1915
663	Nov. 13, 1915	C. B. Sherwood	Schedules 3, 4, 5, Ironstone Canal.	16,681.50	[1] 16,691.90	Apr. 22, 1916
672	Nov. 18, 1915	Mendenhall, Bird & Co.	Schedules 1, 2, Ironstone Canal.	30,006.50	[1] 33,025.86	Mar. 30, 1916
683	Mar. 16, 1916	Orman Construction Co.	Peach Valley lateral	9,626.79	9,843.21	July 19, 1916

IDAHO, BOISE PROJECT.

548	June 5, 1914	Joshua Hendy Iron Works.	Balanced valves	$64,317.00	[1] $64,343.36	Apr. 14, 1915
	Nov. 30, 1914	Union Iron Works Co.	Ejector valves	660.00	[1] 660.00	May 15, 1915
620	Mar. 6, 1915	Chicago Bridge & Iron Co.	Steel gates	7,230.00	[1] 8,239.71	Jan. 28, 1915
	Oct. 21, 1915	Fisher, Hight & Charity.	Canal widening, Divisions 14B, 15B, 16B.	1,137.00	[1] 1,037.31	Jan. 8, 1916
	Oct. 22, 1915	F. L. Rose	Canal widening, Divisions 1B-5B, 13B, 17B, 18B.	3,228.50	[1] 2,534.33	Jan. 15, 1916
	Oct. 30, 1915	Lars Aarland	Canal widening, Divisions 6B-12B.	2,429.00	[1] 2,564.82	Jan. 21, 1916
	Dec. 9, 1915	Cleveland Crane & Engineering Co.	Gantry crane	4,600.00	[1] 5,800.00	Oct. 10, 1915
	Mar. 18, 1916	Lars Aarland	Gibbons drain, Division 1.	989.00	[1] 875.42	June 4, 1916

[1] Completed.

NOTE.—*Boise project.*—In addition to the above there is a contract dated Aug. 15, 1912, between the United States and the Pioneer Irrigation District, whereby the United States agrees to construct a drainage system at a cost of $350,000. This work is now nearly completed. Also a contract dated July 24, 1914, between the United States and the Nampa-Meridian District whereby the United States agrees to construct a drainage system to a cost of $557,000. This work is now 40 per cent completed.

Principal current contracts—Continued.

IDAHO, MINIDOKA PROJECT.

No.	Date.	Contractor.	Description.	Estimated value.	Estimated earnings, June 30, 1915.	Completion due.
	Nov. 11, 1915	Penn Bridge Co.	Winches for radial gates.	$948.00	$680.40	Apr. 29, 1916

MONTANA, FLATHEAD (INDIAN) PROJECT.

634	Mar. 22, 1915	A. L. Markhus	Pablo canals, lateral A and sublaterals.	$16,570.00	[1] $15,415.31	July 20, 1915
639	July 8, 1915	Two Miracle Concrete Corporation.	Structures, Pablo laterals A, 31A, and sublaterals.	31,383.75	[1] 31,579.36	Dec. 1, 1915
	July 20, 1915	Wilson Bros	Earthwork and structures, Pablo laterals 7P and 8Z.	2,539.45	[1] 2,827.43	Oct. 24, 1915
653	Oct. 1, 1915	J. E. Hilton	Earthwork and structures, Pablo laterals A, 31A, 73A, and sublaterals.	30,254.01	[1] 28,365.84	May 15, 1916
666	Nov. 9, 1915	Wilson Bros	Mission H, canal and sublaterals.	16,423.40	[1] 19,350.48	May 31, 1916
	Jan. 25, 1916	Pacific Tank & Pipe Co.	Wood-stave pipe, lateral R, Jocko River crossing.	1,568.90	[1] 1,568.90	Apr. 20, 1916
688	Apr. 10, 1916	Vulcan Iron Works Co.	Steel gates	6,350.50	....	Aug. 2, 1916
693	Apr. 20, 1916	Percy M. Ross	Earthwork and structures, Mission, Post, and Pablo divisions.	13,955.00	6,582.16	Sept. 30, 1916
695	May 8, 1916	C. B. Long	Earthwork and structures, Jocko division, laterals E, J, L, M, N, R.	9,385.00	6,872.61	Sept. 30, 1916
	May 29, 1916	Earl D. Covell	North Pablo by-pass canal.	3,904.05	3,610.00	June 30, 1916
711	June 23, 1916	Mendenhall, Bird & Co.	Earthwork, Pablo division, laterals 70A, 71A, and sublaterals.	29,500.00	....	Dec. 15, 1916

MONTANA, MILK RIVER PROJECT.

553	June 23, 1914	W. J. Hoy Co.	Earthwork and structures, Vandalia Point.	$42,641.10	[1] $47,776.65	July 31, 1915
563	July 23, 1914	Security Bridge Co.	Earthwork and structures, Dodson South Canal.	48,934.85	[1] 61,701.04	Aug. 10, 1915
594	Nov. 20, 1914	.....do	Earthwork and structures, Nelson Reservoir.	28,459.90	[1] 28,942.28	Aug. 31, 1915
603	Dec. 1, 1914	James O'Connor	Earthwork, Dodson South Canal.	33,895.00	[1] 35,522.40	June 30, 1915
641	June 14, 1915	.....do	Earthwork, Nelson Reservoir South Canal.	15,615.00	[1] 13,458.32	Oct. 3, 1915
651	Sept. 27, 1915	Winston Bros. Co.	.....do	41,930.00	[1] 39,978.42	July 8, 1916
656	Oct. 21, 1915	Snelson Bros	.....do	7,490.00	6,594.20	July 15, 1916
658	Nov. 1, 1915	Jurgens, Booth & Co.	Earthwork and structures, Bowdoin Canal.	17,756.00	17,674.27	July 10, 1916
659	Oct. 29, 1915	James O'Connor	Earthwork, Bowdoin Canal.	18,618.50	18,140.25	June 30, 1916
660	Nov. 1, 1915	Jurgens, Booth & Co.	Structures, Nelson Reservoir South Canal.	34,081.50	13,431.25	Sept. 1, 1916
662	Nov. 6, 1915	Lakeside Bridge & Steel Co.	Movable crest, Vandalia division dam.	16,368.75	....	
664	Nov. 19, 1915	.....do	Hoisting machinery	16,301.00	....	
692	Apr. 19, 1916	L. W. Dotson	Earthwork, Bowdoin Canal system.	9,105.95	6,409.00	July 30, 1916
694	May 15, 1916	Security Bridge Co.	Structures, Bowdoin Canal system.	12,940.00	180.00	Oct. 31, 1916

[1] Completed.

MONTANA, MILK RIVER PROJECT—Continued.

No.	Date.	Contractor.	Description.	Estimated value.	Estimated earnings, June 30, 1915.	Completion due.
696	May 26, 1916	Vulcan Iron Works Co.	Gates and stands......	$4,928.00	....	Oct. 1, 1916
701	May 29, 1916	Joshua Hendy Iron Works.	.....do..................	1,170.00	....	July 25, 1916
702	June 13, 1916	Lakeside Bridge & Steel Co.	.....do..................	1,022.00	....	Aug. 17, 1916
	June 24, 1916	K. O. Merrifield.....	Telephone line........	1,399.00	....	Aug. 31, 1916

MONTANA, MILK RIVER PROJECT, ST. MARY STORAGE UNIT.

501	July 12, 1913	Adelbert Cazier.....	Earthwork, schedule 4.	$109,232.17	[1]$109,098.17	Sept. 30, 1915
510	Aug. 5, 1913	J. E. Hilton.........	Earthwork, schedules 1 and 3.	210,041.31	[1]210,041.31	Oct. 31, 1915
544	May 27, 1914	Midwest Engineering Co.	Earthwork, schedules 8-10, 12-19, 22.	111,732.61	[1]111,732.61	[2]Oct. 31, 1915
547	.....do........	Condon & Williams.	Earthwork, schedules 20 and 21.	95,479.92	[1]100,920.57	Jan. 10, 1916
558	June 27, 1914	.....do...........	Earthwork, schedules 2a, 5, 7, 11.	183,361.63	[1]189,705.11	Dec. 20, 1915
579	Sept. 9, 1914	Chicago Bridge & Iron Works.	St. Mary & Hall's Coulee pressure pipes	49,860.78	[1]49,860.78	Oct. 25, 1915
618	Mar. 12, 1915	Minneapolis Bridge Co.	Highway and pipe bridge.	6,559.30	[1]6,559.30	July 19, 1915
	Apr. 3, 1915	Wm. M. Williams...	Pipe trenches.........	2,831.26	[1]2,831.26	July 10, 1915
	Apr. 16, 1915	L. Thompson.......	Concrete piers.........	3,458.61	[1]3,458.61	July 12, 1915
640	July 12, 1915	Hardie-Tynes Mfg. Co.	Slide gates............	3,815.50	[1]3,994.52	Aug. 15, 1915
643	July 23, 1915	Power & Mining Machinery Co.	Cylinder gates.........	6,777.57	[1]7,022.97	Oct. 12, 1915
	Aug. 25, 1915	Walker Manufacturing Co.	Gate-stem braces and brackets.	408.08	[1]408.08	Sept. 25, 1915
	Sept. 22, 1915	.....do.............	Gate stems...........	549.50	[1]549.50	Nov. 9, 1915
	Nov. 5, 1915	Vulcan Iron Works..	Cylinder-gate operating machinery.	731.50	[1]731.50	Dec. 27, 1915
	Nov. 8, 1915	Walker Manufacturing Co.	Gate stems...........	2,114.00	[1]2,137.50	Jan. 31, 1916
667	Nov. 26, 1915	Lakeside Bridge & Steel Co.	Operating mechanism for slide gates.	5,555.00	....	Feb. 24, 1916
	Jan. 13, 1916	Vulcan Iron Works..	Winches for radial gates.	1,425.80	[1]1,539.60	Apr. 13, 1916
684	Mar. 31, 1916	Rumsey Pump Co...	Pressure pump........	730.00	[1]730.00	Do.
	June 3, 1916	Continental Bridge Co.	Footbridge............	1,265.00	....	Aug. 22, 1916

MONTANA, SUN RIVER PROJECT.

	Feb. 19, 1913	Great Falls Power Co.	Electrical energy......	$60,000.00	$20,126.86	Sept. 30, 1919
511	Sept. 17, 1913	MacArthur Bros. Co.	Canal excavation, Pishkun Reservoir supply and Sun River slope canals.	954,918.35	[1]954,948.35	Aug. 1, 1916
532	Jan. 24, 1914	Hayden Bros.......	Structures, Pishkun Reservoir supply and Sun River slope canals.	312,524.04	[1]312,524.04	Jan. 16, 1916
610	Jan. 19, 1915	Bates & Rogers Construction Co.	Excavation, Pishkun Reservoir supply canal.	31,390.05	[1]31,390.05	Aug. 30, 1915
615	Feb. 2, 1915	O'Connor & Helean.	Excavation, Greenfields canals.	62,806.35	[1]62,806.35	Nov. 7, 1915
649	Sept. 2, 1915	West Coast Construction Co. and Hans Pederson.	Structures, Greenfields distribution system.	67,200.00	12,047.77	July 26, 1916
650	Aug. 30, 1915	Threet Bros. & Jolley.	Highway bridges, Greenfields distribution system.	9,030.00	8,924.44	July 24, 1916
654	Sept. 18, 1915	J. E. Hilton.........	Laterals, Greenfields distribution system.	48,000.00	35,931.17	Do.

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[1] Completed.

[2] Suspended Dec. 9, 1914; completed by Government forces.

Principal current contracts—Continued.

MONTANA, SUN RIVER PROJECT—Continued.

No.	Date.	Contractor.	Description.	Estimated value.	Estimated earnings, June 30, 1915.	Completion due.
	Nov. 26, 1915	Vulcan Iron Works..	Gates and frames......	$2,547.00	[1]$2,521.53	Jan. 15, 1916
	Nov. 29, 1915	Walker Manufacturing Co.	Gate stands and stems.	670.16	[1]663.46	Jan. 8, 1916
682	Feb. 21, 1916	Des Moines Bridge & Iron Co.	Steel highway and pipe bridge.	9,000.00	7,000.00	
699	June 10, 1916	Pacific Tank & Pipe Co.	Wood stave pipe......	7,817.50	....	

NEBRASKA-WYOMING, NORTH PLATTE PROJECT.

652	Sept. 30, 1915	Winston Bros. Co...	Earthwork, schedules 1 and 2, first division, Fort Laramie Canal.	$121,347.60	[1]$114,155.22	July 1, 1916
655	Oct. 4, 1915	Fred M. Crane Co....	Earthwork, schedules 3 and 4, first division, Fort Laramie Canal.	77,960.00	70,413.56	Aug. 5, 1916
	Oct. 11, 1915	B. A. Chapman.....	Camp buildings.......	974.30	[1]1,073.43	Dec. 15, 1915
689	Apr. 15, 1916	Security Bridge Co..	Laramie River and Deer Creek siphons.	39,877.00	1,750.00	Oct. 31, 1916
690	Apr. 10, 1916	MacArthur Bros. Co.	Earthwork, schedules 1, 2, 3, 4, second division, Fort Laramie Canal.	153,605.00	17,889.00	Dec. 1, 1916
691	.....do.......	.....do.............	3 concrete culverts....	18,265.00	570.00	Oct. 31, 1916
	June 3, 1916	W. W. Groves......	Schedule 1, Indian Creek Wasteway.	286.00	....	June 30, 1916
697	June 13, 1916	MacArthur Bros. Co.	2 tunnels.............	242,032.50	....	June 30, 1917
700	June 22, 1916	.....do.............	Earthwork, schedule 1, third division, Fort Laramie Canal.	38,225.00	....	Dec. 31, 1916
704	.....do.......	Winston Bros. Co...	Earthwork, schedule 2, third division, Fort Laramie Canal.	29,180.00	....	Do.

NEW MEXICO-TEXAS, RIO GRANDE PROJECT.

677	Dec. 18, 1915	H. E. Williams.....	San Elizario feed canal, schedule 8.	$3,149.50	[1]$2,891.02	Feb. 28, 1916
679	Dec. 20, 1915	Toohey & Johnson..	Leasburg and Picacho canals, schedules 1-7.	23,008.00	[1]18,453.14	Mar. 14, 1916
681	Jan. 4, 1916	John Mulligan.......	San Elizario feed canal, schedule 9.	2,838.00	[1]2,289.49	Feb. 28, 1916

NEW MEXICO-TEXAS, RIO GRANDE PROJECT, ELEPHANT BUTTE STORAGE.

	Feb. 20, 1911	Mountain States Telephone & Telegraph Co.	Telephone service.....	$10,800.00	$9,015.72	June 30, 1917
	Aug. 1, 1914	West Texas Fuel Co.	Coal..................	1,215.00	[1]1,014.39	Aug. 1, 1915
	Oct. 28, 1914	Darbyshire & Evans	.....do..............	20,750.00	[1]21,154.85	Nov. 30, 1915
	Mar. 11, 1915	Trump Manufacturing Co.	Hydro-electric machinery.	2,540.00	[1]2,540.30	June 17, 1915
	Mar. 12, 1915	General Electric Co..	.....do..............	1,700.00	[1]1,630.00	Apr. 22, 1915
	June 2, 1915	Consolidated Film & Supply Co.	Films................	600.00	[1]591.45	
	Dec. 7, 1915	Heid Brothers.......	Coal..................	4,950.00	[1]3,487.01	Mar. 30, 1916
	Dec. 13, 1915	Railways Ice Co.....	Ice...................	480.00	384.75	July 31, 1916
	Jan. 17, 1916	Imperial Laundry Co.	Laundry service.......	300.00	121.96	
	Feb. 23, 1916	Victorio Land & Cattle Co.	Lease of land.........	500.00	35.34	Mar. 1, 1921
	Mar. 15, 1916	Atchison, Topeka & Santa Fe Railway.	Train service.........	7,000.00	1,200.00	Apr. 1, 1921

[1] Completed.

Principal current contracts—Continued.

OREGON, UMATILLA PROJECT.

No.	Date.	Contractor.	Description.	Estimated value.	Estimated earnings, June 30, 1915.	Completion due.
	May 20, 1915	Newport Land & Construction Co.	Section 5, main canal, west extension.	$3,190.00	[1] $3,219.48	July 10, 1915

SOUTH DAKOTA, BELLE FOURCHE PROJECT.

657	Sept. 18, 1915	Curtis Bros..........	Schedules 1 and 2, North Canal, extension and laterals.	$8,771.00	$3,599.88	June 21, 1916
661	Nov. 10, 1915	Pacific Tank & Pipe Co.	Wood stave pipe......	12,541.65	6,270.83	June 1, 1916

UTAH, STRAWBERRY VALLEY PROJECT.

599	Dec. 7, 1914	MacArthur Bros. Co.	High Line Canal, division 3.	$37,078.50	[1] $50,885.16	Oct. 3, 1915
01	Dec. 8, 1914	Mendenhall, Straw & Bird Construction Co.	High Line Canal, division 1.	47,465.00	[1] 64,087.56	Nov. 20, 1915
602	Dec. 11, 1914	Rideout & Andrus..	High Line Canal, division 2.	25,897.50	[1] 37,814.62	Nov. 11, 1915
622	Mar. 16, 1915	Wasatch Grading Co.	High Line Canal, division 5.	47,083.62	[1] 58,277.86	Sept. 15, 1915
624	Mar. 13, 1915	Reynolds-Ely Construction Co.	High Line Canal, division 4.	82,624.75	[1] 88,674.88	Oct. 24, 1915
629	Mar. 29, 1915	Spanish Fork Grading Co.	High Line Canal, division 6.	22,196.25	[1] 23,692.71	Sept. 22, 1915
635	May 7, 1915	Green Construction Co.	High Line Canal, division 7.	14,300.00	[1] 7,920.27	[2] Sept. 15, 1915
636	June 9, 1915	Morrison - Knudsen Co.	High Line Canal, division 8.	38,950.35	[1] 48,437.69	Oct. 24, 1915
	May 12, 1915	Lacy Manufacturing Co.	Steel riveted pipe.....	627.00	[1] 607.00	July 6, 1915
647	Aug. 18, 1915	Heuser, Sim & Vorlink.	High Line Canal, division 9, laterals.	35,504.10	33,714.55	Dec. 15, 1915

WASHINGTON, OKANOGAN PROJECT.

550	June 22, 1914	Pelton Water Wheel Co.	Hydraulic apparatus..	$6,241.00	[1] $6,689.00	Oct. 20, 1915
559	July 2, 1914	Allis-Chalmers Mfg. Co.	Electrical apparatus...	6,550.00	[1] 6,470.00	Oct. 8, 1914
560	July 1, 1914	General Electric Co..	.....do................	2,709.65	[1] 2,709.65	Oct. 26, 1914
	May 28, 1914	Chas. C. Moore & Co.	Hydraulic apparatus..	2,450.00	[1] 2,145.00	Aug. 17, 1914

WASHINGTON, YAKIMA-STORAGE PROJECT.

640	July 12, 1915	Hardie-Tynes Mfg. Co.	Slide gates............	$3,815.50	[1] $3,994.52	Aug. 30, 1915
643	July 23, 1915	Power & Mining Machinery Co.	Cylinder gates.........	6,776.93	[1] 6,899.63	Oct. 12, 1915
667	Nov. 26, 1915	Lakeside Bridge Steel Co.	Operating mechanism for slide gates.	2,777.50	....	Feb. 24, 1916
684	Mar. 31, 1916	Rumsey Pump Co...	Pressure pump........	730.00	[1] 730.00	Apr. 13, 1916

WASHINGTON, YAKIMA-SUNNYSIDE PROJECT.

591	Nov. 11, 1914	Pelton Water Wheel Co.	Hydraulic machinery.	$7,867.00	[1] $8,372.20	Feb. 10, 1915
625	Mar. 25, 1915	Chas. C. Moore & Co.	.....do................	10,611.00	6,878.25	July 31, 1915
	Oct. 29, 1915	R. R. Swain.........	Gravel.................	595.00	[1] 595.00	Feb. 8, 1916
	Oct. 30, 1915	F. L. Rinehold......	.....do................	1,024.80	[1] 1,024.80	Do.

[1] Completed.

[2] Suspended Sept. 18, 1915.

Principal current contracts—Continued.

WYOMING, SHOSHONE PROJECT.

No	Date.	Contractor.	Description.	Estimated value.	Estimated earnings, June 30, 1915.	Completion due.
665	Nov. 17, 1915	Threet Bros. & Jolley.	Earthwork, Frannie division, schedules 1 and 3.	$78,760.00	$41,624.35	Sept. 30, 1916
674	Nov. 29, 1915	R. M. Lynn..........	Earthwork, Frannie division, schedule 2.	27,076.00	13,821.14	Do.
698	June 9, 1916	Security Bridge Co..	Structures, Frannie division, schedule 1.	15,735.96	....	Nov. 30, 1916

CEMENT.

Contracts for cement.

[The table contains data relating to the contracts for cement in operation or completed during the fiscal year ending June 30, 1916.]

No.	Date.	Contractor.	Price per barrel f. o. b. works.	Estimated number of barrels.	Estimated value.	Estimated earnings June 30, 1916.	Completion due.
434	Mar. 1, 1912	Riverside Portland Cement Co.	$1.37½	12,000	$16,500	$12,124.25	June 30, 1916
463	Nov. 8, 1912	Ogden Portland Cement Co.	.99	130,000	128,700	[1] 154,440.00	Dec. 31, 1915
534	Mar. 10, 1915	Lehigh Portland Cement Co.	1.00	13,000	13,000	[1] 10,776.40	May 1, 1915
555	June 26, 1914	Ogden Portland Cement Co.	1.33	5,500	7,315	[1] 7,165.55	Do.
611	Jan. 20, 1915	Southwestern Portland Cement Co.	1.40	45,000	63,000	[1] 70,508.59	June 30, 1915
626	Mar. 15, 1915	Union Portland Cement Co.	1.10	24,000	26,400	[1] 33,000.00	June 30, 1916
638	July 13, 1915	Southwestern Portland Cement Co.	1.30	12,000	15,600	9,691.95	Do.
642	do	Pacific Portland Cement Co.	1.40	5,500	7,700	8,355.80	Do.
644	July 15, 1915	Three Forks Portland Cement Co	1.25	17,000	21,250	18,447.00	Do.
645	July 2, 1915	Lehigh Portland Cement Co.	1.00	47,000	47,000	39,595.30	Do.
646	July 14, 1915	Iola Portland Cement Co.	.55	52,000	77,774	73,968.86	Do.
648	July 19, 1915	Ogden Portland Cement Co.	1.10	21,000	23,100	33,124.50	Do.
685	Mar. 25, 1916	United States Portland Cement Co.	.97	8,000	7,760	863.10	Do.
686	Mar. 27, 1916	Union Portland Cement Co.	1.30	2,800	3,640	1,382.10	Do.

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[1] Completed.

Purchases of cement during fiscal year 1916.

Contract No.:	Barrels.
463	2,850
611	2,450
626	1,709
638	6,700
642	5,365
644	11,180
645	33,202
646	59,681
648	26,250
685	630
686	813
Total	150,830

Tabulation of cement tests from

[Average of accepted cement.]

Brand.	Quantity (barrels).	Fineness.		Setting time.		Specific gravity.	Composition of briquets.	Tensile strength.			
		Per cent passing No. 100 sieve.	Per cent passing No. 200 sieve.	Initial.	Final.			1 day.		7 days.	
								Number of briquets.	Pounds per square inch.	Number of briquets.	Pounds per square inch.
				H. m.	*H. m.*						
Ash Grove	30,850	95.6	82.2	3 51	7 25	3.16	Neat	30	361	655	766
							3 to 1	......	......	655	348
Atlas (Hannibal, Mo.)	17,690	96.2	78.2	1 45	5 02	3.17	Neat	30	353	385	603
							3 to 1	......	......	385	235
Concrete	15,640	98.5	83.8	3 50	6 31	3.13	Neat	30	376	423	719
							3 to 1	......	......	423	354
Cowboy	21,395	96.2	76.6	3 09	6 20	3.15	Neat	40	314	712	749
							3 to 1	......	......	712	279
Dewey	14,206	96.6	80.1	3 45	6 40	3.15	Neat	15	407	225	728
							3 to 1	......	......	225	323
El Toro	344,563	93.3	77.5	2 48	5 33	3.16	Neat	365	354	5,164	689
							3 to 1	......	......	5,164	259
Golden Gate	225,548	95.7	77.9	3 23	5 51	3.12	Neat	105	314	7,352	650
							3 to 1	......	......	7,352	215
Ideal	246,181	96.4	80.2	3 46	7 12	3.14	Neat	115	358	4,432	688
							3 to 1	......	......	4,432	303
Inland, Lehigh (Metaline Falls, Wash.).[1]	59,252	95.4	79.1	3 21	5 38	3.14	Neat	40	356	1,403	707
							3 to 1	......	......	1,403	315
Iola	175,728	94.1	78.3	3 53	7 51	3.16	Neat	125	371	3,447	768
							3 to 1	......	......	3,447	314
Lehigh (Mason City, Iowa).	15,335	95.8	79.1	3 35	5 .58	3.17	Neat	25	375	404	693
							3 to 1	......	......	404	299
Marquette	32,155	94.7	77.3	3 18	7 05	3.15	Neat	35	384	635	724
							3 to 1	......	......	635	296
Mount Diablo	43,740	95.0	78.8	3 40	6 22	3.13	Neat	30	386	433	668
							3 to 1	......	......	433	240
Ogden	233,439	97.1	79.2	4 06	7 20	3.16	Neat	85	298	4,274	646
							3 to 1	......	......	4,274	283
Red Devil (Devil's Slide, Utah).	285,816	96.5	78.3	3 43	6 25	3.14	Neat	95	372	4,967	734
							3 to 1	......	......	4,967	333
Red Devil (Trident, Mont.).	98,504	97.5	83.0	3 37	6 12	3.14	Neat	80	336	2,113	681
							3 to 1	......	......	2,113	333
Red Diamond, Utah[2]	54,559	96.9	79.7	4 13	7 40	3.15	Neat	80	352	2,365	639
							3 to 1	......	......	2,365	317
Riverside	26,100	96.2	80.2	4 48	7 59	3.13	Neat	25	360	555	685
							3 to 1	......	......	555	304
Spokane	26,500	95.5	80.3	3 13	5 55	3.11	Neat	20	355	568	791
							3 to 1	......	......	568	361
Standard (Napa Junction, Cal.).	43,691	97.2	82.2	4 07	6 58	3.11	Neat	45	265	692	656
							3 to 1	......	......	692	251
Sunflower (Independence, Kans.).	7,055	95.8	79.1	2 32	6 32	3.17	Neat	15	422	133	880
							3 to 1	......	......	133	379
Sunflower (Iola, Kans.).	87,975	94.2	78.0	3 30	7 24	3.15	Neat	55	347	1,242	783
							3 to 1	......	......	1,242	278
Universal (South Chicago, Ill.).	184,100	96.9	81.0	3 24	7 26	3.14	Neat	70	343	3,635	659
							3 to 1	......	......	3,635	263
Yankton	28,484	96.3	80.4	3 53	8 28	3.21	Neat	85	261	945	644
							3 to 1	......	......	945	252
Total	2,318,506	95.7	79.1	3 34	6 41	3.14	Neat	1,640	347	47,159	690
							3 to 1	......	......	47,159	284

[1] Made at same plant. Brand name changed from Inland to Lehigh April, 1914.
[2] Made at same plant. Brand name changed from Red Diamond to Utah June, 1910.

Jan. 1, 1904, to June 30, 1916.

[Average of accepted cement.]

Tensile strength.																	
28 days.		3 months.		6 months.		1 year.		2 years.		3 years.		5 years.		7½ years.		10 years.	
Number of briquets.	Pounds per square inch.	Number of briquets.	Pounds per square inch.	Number of briquets.	Pounds per square inch.	Number of briquets.	Pounds per square inch.	Number of briquets.	Pounds per square inch.	Number of briquets.	Pounds per square inch.	Number of briquets.	Pounds per square inch.	Number of briquets.	Pounds per square inch.	Number of briquets.	Pounds per square inch.
655	797	40	770	40	757	40	732	40	759	40	750	30	737	5	639	.....	.....
655	452	40	470	40	459	40	439	40	439	40	432	30	450	5	406	.....	.....
385	667	30	705	30	670	30	689	30	739	30	692	30	690	5	681	.....	.....
385	358	30	467	30	437	30	439	30	413	30	405	30	416	5	404	.....	.....
423	753	30	802	30	757	30	759	20	686	15	652	15	671	5	684	.....	.....
423	438	30	468	30	462	30	466	20	413	15	406	15	409	5	426	.....	.....
712	871	40	846	40	843	40	808	30	775	30	735	30	727	25	695	5	750
712	396	40	443	40	448	40	441	30	438	30	419	30	427	25	437	5	406
225	787	15	769	15	831	15	788	10	744	5	740	5	754	.....	.....	.....	.....
225	417	15	450	15	469	15	457	10	435	5	423	5	427	.....	.....	.....	.....
5,162	795	420	702	290	822	175	832	70	798	55	789	40	788	.....	.....	.....	.....
5,162	345	420	342	290	423	175	427	70	427	55	444	40	447	.....	.....	.....	.....
5,986	787	245	761	100	709	90	694	85	679	80	693	35	654	.....	.....	.....	.....
5,986	342	245	437	100	428	90	407	85	416	80	415	35	427	.....	.....	.....	.....
4,436	737	120	723	120	723	120	702	115	709	105	694	90	666	60	672	30	676
4,436	403	120	451	120	454	120	465	115	451	105	433	90	425	60	417	30	406
1,403	761	35	795	25	783	15	779	15	771	.....	.....	.....	.....	.....	.....	.....	.....
1,403	434	35	454	25	437	15	419	15	351	.....	.....	.....	.....	.....	.....	.....	.....
3,447	839	140	841	130	794	125	791	125	774	120	754	110	722	55	754	15	682
3,447	431	140	453	130	449	125	420	125	413	120	390	110	401	55	400	15	422
404	758	25	757	25	751	25	775	20	781	10	713	.....	.....	.....	.....	.....	.....
404	433	25	459	25	446	25	436	20	409	10	441	.....	.....	.....	.....	.....	.....
635	822	35	755	35	737	35	724	35	749	35	704	35	706	25	714	.....	.....
635	402	35	441	35	447	35	446	35	459	35	437	35	434	25	436	.....	.....
433	738	35	759	30	721	30	707	30	693	30	715	5	655	.....	.....	.....	.....
433	341	35	414	30	431	30	414	30	406	30	410	5	350	.....	.....	.....	.....
4,274	725	85	755	75	752	75	757	45	744	25	728	5	662	.....	.....	.....	.....
4,274	401	85	448	75	454	75	451	45	449	25	434	5	433	.....	.....	.....	.....
4,967	798	105	795	105	792	100	780	65	787	50	767	40	759	10	778	.....	.....
4,967	432	105	454	105	456	100	430	65	406	50	419	40	378	10	415	.....	.....
2,113	730	75	734	70	725	65	703	45	702	30	651	10	647	.....	.....	.....	.....
2,113	449	75	478	70	462	65	461	45	455	30	446	10	392	.....	.....	.....	.....
2,370	711	95	722	95	751	90	759	80	771	80	744	45	709	40	695	40	681
2,370	418	95	469	95	486	90	481	80	446	80	424	45	408	40	412	40	402
555	731	25	739	25	773	25	754	15	756	10	716	.....	.....	.....	.....	.....	.....
555	402	25	448	25	456	25	444	15	429	10	425	.....	.....	.....	.....	.....	.....
568	826	25	766	25	745	20	752	5	741	.....	.....	.....	.....	.....	.....	.....	.....
568	441	25	446	25	430	20	422	5	372	.....	.....	.....	.....	.....	.....	.....	.....
713	756	50	732	40	736	40	770	20	683	10	654	10	608	.....	.....	.....	.....
713	357	50	478	40	494	40	521	20	499	10	506	10	481	.....	.....	.....	.....
133	927	15	925	15	881	15	824	15	803	15	739	15	782	10	819	.....	.....
133	504	15	496	15	504	15	470	15	467	15	445	15	450	10	421	.....	.....
1,242	874	55	820	55	807	55	765	55	755	55	744	50	705	45	752	10	707
1,242	424	55	434	55	424	55	387	55	367	55	373	50	364	45	377	10	339
3,635	803	70	860	70	817	70	799	70	781	70	751	70	745	65	741	20	748
3,635	375	70	420	70	407	70	402	70	372	70	346	70	351	65	356	20	347
945	775	60	791	60	785	60	773	60	748	60	768	60	732	40	767	5	589
945	357	60	433	60	440	60	430	60	414	60	420	60	412	40	407	5	411
45,821	778	1,870	759	1,545	774	1,385	762	1,100	748	960	731	730	714	390	727	125	692
45,821	395	1,870	426	1,545	445	1,385	438	1,100	423	960	414	730	468	390	401	125	392

NOTE.—In considering the results of long-time tests, as shown above, it should be borne in mind that while the results for the different periods are approximately comparable they are not directly comparable, as in most cases there is a difference in the number of briquets represented by the results for various periods on the different brands, owing to the fact that new sets are being started from time to time, the results of which become available at different periods.

UNIT BIDS AND CONTRACT PRICES.

Unit bids and contract prices on formal specifications.

BACKFILLING.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Montana, Flathead	Aug. 18, 1915	308	Pablo lateral 31A, schedule 2	Cubic yard	1,800	$0.20	$0.25	$0.25
Do	do	308	Pablo laterals A and 73A, schedule 3	do	5,000	.20	.25	.25
Do	Oct. 12, 1915	318	Mission lateral H	do	2,000	.15	.20	.20
Do	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, and R, schedule 2	do	650	.25	.40	Rejected.
Do	do	324	Jocko River crossing, schedule 3	do	80	.30	.50	Rejected.
Do	Mar. 23, 1916	328	Mission division, schedule 1	do	100	.25	.25	.25
Do	do	328	Post division, schedule 2	do	1,750	.25	.25	.25
Do	do	328	Pablo division, schedule 3	do	420	.25	.25	.25
Do	Mar. 29, 1916	330	Jocko division, schedule 2	do	650	.25	.25	.25
Do	May 25, 1916	333	Pablo division, 31A sublaterals, schedule 2	do	1,850	.30	.40	.30
Do	do	333	Pablo division, 70A and 71A laterals, schedule 4.	do	3,360	No bids.		
Montana, Milk River	Sept. 20, 1915	315	Bowdoin Canal, first unit, structures	do	600	.10	.15	.10
Do	Apr. 25, 1916	[1] 327	Bowdoin Canal system, first unit, structures	do	3,600	.18	.21	.25
Nebraska-Wyoming, North Platte	Mar. 10, 1916	325	Fort Laramie Canal, siphons	do	2,800	.20	.30	.20
Do	do	325	Fort Laramie Canal, culverts	do	500	.20	.30	.50
Do	May 22, 1916	334	Fort Laramie Canal, tunnel approaches	do	400	.25	.50	.50
Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1.	do	1,200	.50	.50	.50
Do	do	337	High Line Canal, division 10, laterals, schedule 2.	do	1,000	.40	.50	.50
Do	do	337	High Line Canal, division 10, laterals, schedule 3.	do	800	.50		.50
Wyoming, Shoshone	May 3, 1916	331	Frannie division, schedule 1, dry	do	2,000	.25	.25	.25
Do	do	331	Frannie division, schedule 2, dry	do	10,000	.25	.26	(2)
Do	do	331	Frannie division, schedule 1, puddled	do	300	.50	.75	.75
Do	do	331	Frannie division, schedule 2, puddled	do	1,000	.50	.75	(2)

BRIDGE, STEEL HIGHWAY AND PIPE.

Montana, Sun River	Jan. 24, 1916	17D	2 110-foot spans	No		$5,947.00	$6,743.00	$7,000.00
Do	do	17D	Erecting	do		2,000.00	2,460.00	2,000.00

CHAIN SHAFTS AND CHAINS FOR ROLLING CRESTS, GRAND RIVER DIVERSION DAM.

Colorado, Grand Valley	Nov. 8, 1915	F6	1 chain shaft, operating chain, and guard chain for 60-foot roller; 6 chain shafts, operating chains, and guard chains for 70-foot rollers. Total weight 29,896 pounds.	Total		$5,147.00		$5,147.00
Do	do	F6	1 safety chain for 60-foot roller and 6 safety chains for 70-foot rollers. Total weight 7,967 pounds.	do		891.00		

CONCRETE.

Montana, Flathead	June 30, 1915	F2	Pablo canals, laterals 7P and 8Z, schedule 2	Cubic yard	41	$14.00	$17.50	$14.00
Do	Aug. 18, 1915	308	Lateral 31A, structures, schedule 2	do	140	13.50	15.00	15.90
Do	do	308	Pablo laterals A and 73A and sublaterals, schedule 3.	do	420	15.90	16.00	15.90
Do	Oct. 12, 1915	318	Mission lateral H	do	140	14.00	16.80	17.00
Do	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, R, schedule 2	do	250	18.00	24.90	Rejected.
Do	do	324	Jocko River crossing, schedule 3	do	40	19.00	35.85	Rejected.
Do	Mar. 23, 1916	328	Mission division, schedule 1	do	10.5	19.00	19.00	19.00
Do	do	328	Post division, schedule 2	do	175.5	19.00	19.00	19.00
Do	do	328	Pablo division, schedule 3	do	44	19.00	19.00	19.00
Do	Mar. 29, 1916	330	Jocko division, schedule 2	do	250	16.00	16.00	16.00
Do	May 25, 1916	333	Pablo division, sublateral 31A, schedule 2	do	270	16.00	19.00	16.00
Do	do	333	Pablo division, laterals 70A and 71A, schedule 3.	do	600	No bids.		
Montana, Milk River	Sept. 20, 1915	314	Nelson Reservoir South Canal, structures	do	1,700	8.80	10.00	8.80
Do	do	315	Bowdoin Canal, first unit structures	do	450	8.80	10.20	8.80
Do	Apr. 25, 1916	[1] 327	Bowdoin Canal system, first unit structures	do	390	12.75	14.00	14.50
Nebraska-Wyoming, North Platte	Mar. 10, 1916	325	Fort Laramie Canal, siphons	do	2,000	7.75	9.35	9.35
Do	do	325	Fort Laramie Canal, culverts	do	1,350	8.00	9.35	8.00
Do	May 22, 1916	334	Fort Laramie Canal, tunnel and approaches	do	10,700	6.90	7.50	6.90
Do	do	334	Fort Laramie Canal, canal lining	do	1,250	5.00	6.75	6.75
Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1.	do	500	18.00	18.00	18.00
Do	do	337	High Line Canal, division 10, laterals, schedule 2.	do	400	18.00	18.00	18.00
Do	do	337	High Line Canal, division 10, laterals, schedule 3.	do	600	18.00		18.00
Wyoming, Shoshone	May 3, 1916	331	Frannie division, schedule 1	do	580	13.80	14.00	14.10
Do	do	331	Frannie division, schedule 2	do	900	15.00	15.50	[2]

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[1] Reissue.

[2] Not awarded.

Unit bids and contract prices on formal specifications—Continued.

CONCRETE, CANAL LINING.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Montana, Flathead	May 25, 1916	333	Pablo division, 31A sublaterals, schedule 2, 2 inches thick.	Square feet	2,000	$0.10	$0.21	$0.10
Do	....do	333	Pablo division, 31A sublaterals, schedule 2, 4 inches thick.	....do	5,650	.18	.28	.18
Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1, reinforced, 2½ inches thick.	....do	250,000	.10	.10	.10
Do	....do	337	High Line Canal, division 10, laterals, schedule 2, reinforced, 2½ inches thick.	....do	250,000	.10	.10	.10
Do	....do	337	High Line Canal, division 10, laterals, schedule 3, reinforced, 2½ inches thick.	....do	200,000	.11	....	.11

CONCRETE, RUBBLE.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Lowest.	Next.	Contract price.
Montana, Flathead	Feb. 8, 1916	324	Jocko River crossing, schedule 3	Cubic yard	11	$14.00	$26.10	Rejected.

EMBANKMENT ROLLED.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Lowest.	Next.	Contract price.
Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1.	Cubic yard	1,000	$0.10	$0.15	$0.10
Do	....do	337	High Line Canal, division 10, laterals, schedule 2.	....do	7,000	.10	.15	.10
Do	....do	337	High Line Canal, division 10, laterals, schedule 3.	....do	3,000	.10	....	.10

EXCAVATION, CLASS 1 (EARTH).

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Lowest.	Next.	Contract price.
California, Orland	Dec. 15, 1915	....	Relocation of South Canal, division 1	Cubic yard	1,900	$0.24	(1)	$0.24
Do	....do	....	Relocation of South Canal, division 2	....do	1,900	.24	(1)	.24
Do	....do	....	Relocation of South Canal, division 3	....do	1,900	.24	$0.26	.24
Do	....do	....	Relocation of South Canal, division 4	....do	1,900	.24	.26	.24
Do	....do	....	Relocation of South Canal, division 5	....do	1,900	.24	.27	.24
Colorado, Grand Valley	Nov. 4, 1915	320	Main Canal, division 4, schedule 1	....do	30,300	.12	.135	.12
Do	....do	320	Main Canal, division 4, schedule 2	....do	25,100	.12	.135	.12

Do	do	320	Main Canal, division 4, schedule 3	do	19,600	.12	.1275	.12
Do	do	320	Main Canal, division 4, schedule 4	do	23,200	.12	.1275	.12
Do	do	320	Main Canal, division 4, schedule 5	do	20,100	.115	.1275	.115
Do	do	320	Main Canal, division 4, schedule 6	do	15,800	.115	.1275	.115
Do	do	320	Main Canal, division 4, schedule 7	do	16,600	.115	.125	.115
Do	do	320	Main Canal, division 4, schedule 8	do	9,800	.115	.12	.115
Do	do	320	Laterals, second district, schedule 9	do	26,390	.115	.115	.115
Do	do	320	Laterals, second district, schedule 10	do	19,390	.11	.11	.12
Do	do	320	Laterals, second district, schedule 11	do	13,260	.10	.115	.10
Do	do	320	Laterals, second district, schedule 12	do	20,250	.11	.14	.11
Do	do	320	Laterals, second district, schedule 13	do	16,860	.11	.115	.115
Do	do	320	Laterals, second district, schedule 14	do	10,360	.105	.11	.105
Do	do	320	Laterals, second district, schedule 15	do	12,090	.10	.10	
Do	do	320	Laterals, second district, schedule 16	do	11,040	.1175	.12	.12
Colorado, Uncompahgre Valley	Oct. 20, 1915	319	Ironstone Canal, schedule 1	do	32,500	.28½		.28½
Do	do	319	Ironstone Canal, schedule 2	do	48,300	.26½		.26½
Do	do	319	Ironstone Canal, schedule 3	do	31,250	.16½		.16½
Do	do	319	Ironstone Canal, schedule 4	do	33,450	.16½		.16½
Do	do	319	Ironstone Canal, schedule 5	do	30,750	.16½		.16½
Do	Jan. 18, 1916	323	Peach Valley lateral, schedule 1	do	8,000	.15	.17½	.17½
Do	do	323	Peach Valley lateral, schedule 2	do	7,000	.15	.1509	.1509
Do	do	323	Peach Valley lateral, schedule 3	do	6,300	.15	.1509	.1509
Do	do	323	Peach Valley lateral, schedule 4	do	5,900	.15	.17½	.18½
Do	do	323	Peach Valley lateral, schedule 5	do	5,700	.15	.1509	.1599
Do	do	323	Peach Valley lateral, schedule 6	do	6,800	.15	.1509	.1509
Do	do	323	Peach Valley lateral, schedule 7	do	5,500	.15	.17½	.17½
Montana, Flathead	June 30, 1915	F2	Pablo laterals 7P and 8Z, schedule 1	do	5,300	.17	.185	.17
Do	Aug. 18, 1915	308	Pablo lateral 31A, schedule 1	do	25,700	.15	.158	.15
Do	Oct. 12, 1915	318	Mission lateral H	do	40,000	.17	.2066	.17
Do	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, R, schedule 1	do	2,200	.25	.30	Rejected.
Do	Mar. 23, 1916	328	Mission division, schedule 4	do	1,425	.18	.18	.18
Do	do	328	Post division, schedule 5	do	14,350	.18	.18	.18
Do	do	328	Pablo division, schedule 6	do	1,125	.18	.18	.18
Do	Mar. 29, 1916	330	Jocko division, schedule 1	do	2,200	.28	.28	.28
Do	May 25, 1916	333	Pablo division, sublateral, schedule 1	do	86,000	.19	.21	.19
Do	do	333	Pablo division, laterals 70A and 71A, schedule 3.	do	110,000	.21	.21	21
Do	May 26, 1916	F3	Pablo division, By-Pass Canal, schedule 1	do	8,350	.19	.21	.19
Do	do	F3	Pablo division, By-Pass Canal, schedule 2	do	12,045	.19	.21	.19
Montana, Milk River	Aug. 12, 1915	309	Nelson Reservoir South Canal, schedule 1	do	160,000	.139	.150	.139
Do	do	309	Nelson Reservoir South Canal, schedule 2	do	135,000	.132	.134	.139
Do	do	309	Nelson Reservoir South Canal, schedule 3	do	60,000	.119	.139	.119
Do	Sept. 20, 1915	315	Bowdoin Canal, first unit, schedule 1	do	103,000	.127	.134	.127
Do	do	315	Bowdoin Canal, first unit, schedule 2	do	80,000	.154	.17	.17
Do	do	315	Bowdoin Canal, first unit, schedule 3	do	78,000	.138	.140	.138
Do	Mar. 15, 1916	327	Bowdoin Canal system, first unit laterals and waste-water ditches.	do	62,000	.145	.15	.145
Nebraska-Wyoming, North Platte	May 27, 1916	Informal.	Schedule No. 1, Indian Creek Wasteway	do	2,400	.11	.1175	.11
Do	Sept. 8, 1915	313	Fort Laramie Canal, division 1, schedule 1	do	349,000	.144	.15	.144
Do	do	313	Fort Laramie Canal, division 1, schedule 2	do	360,000	.14½	.156	.156

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[1] Only one bid received.

Unit bids and contract prices on formal specifications—Continued.

EXCAVATION, CLASS 1 (EARTH)—Continued.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Nebraska-Wyoming, North Platte	Sept. 8, 1915	313	Fort Laramie Canal, division 1, schedule 3	Cubic yard	297,000	$0.14	$0.14	$0.14
Do	do	313	Fort Laramie Canal, division 1, schedule 4	do	257,000	.13	.144	.13
Do	Mar. 10, 1916	326	Fort Laramie Canal, division 2, schedule 1	do	111,000	.135	.14	.209
Do	do	326	Fort Laramie Canal, division 2, schedule 2	do	160,000	.13	.135	.169
Do	do	326	Fort Laramie Canal, division 2, schedule 3	do	147,000	.135	.14	.225
Do	do	326	Fort Laramie Canal, division 2, schedule 4	do	220,000	.125	.135	.142
Do	May 25, 1916	336	Fort Laramie Canal, division 3, schedule 1	do	124,000	.13	.14	.19
Do	do	336	Fort Laramie Canal, division 3, schedule 2	do	235,000	.12	.13	.12
Do	do	336	Fort Laramie Canal, division 3, schedule 3	do	176,000	.14	.14	.14
Do	do	336	Fort Laramie Canal, division 3, schedule 4	do	147,000	.14	.14	.14
New Mexico-Texas, Rio Grande	Nov. 17, 1915	321	Leasburg Extension Canal, schedule No. 1	do	26,500	.139	.15	.150
Do	do	321	Leasburg Extension Canal, schedule No. 2	do	26,000	.125	.13	.130
Do	do	321	Leasburg Extension Canal, schedule No. 3	do	25,000	.13	.139	.130
Do	do	321	Leasburg Extension Canal, schedule No. 4	do	24,000	.109	.120	.120
Do	do	321	Leasburg Extension Canal, schedule No. 5	do	24,000	.100	.109	.100
Do	do	321	Picacho Branch Canal, schedule No. 6	do	18,000	.135	.150	.150
Do	do	321	Picacho Branch Canal, schedule No. 7	do	18,000	.150	.150	.150
Do	do	321	San Elizario Feeder Canal, schedule No. 8	do	28,500	.109	.1125	.109
Do	do	321	San Elizario Feeder Canal, schedule No. 9	do	25,000	.1125	.135	.1125
Oregon-California, Klamath	Nov 20, 1915		1 D drain, schedules 1 and 2	do	1,577	.15	.17	.15
Do	do		1 D drain, schedules 3, 4, and 5	do	1,856	.15	.20	.15
Do	do		1 H drain, schedule 1	do	920	.159	.30	.159
Do	do		1 H drain, schedule 2	do	768	.14	.155	.14
Do	do		1 H drain, schedule 3	do	1,005	.14	.155	.14
Do	do		1 J drain, schedules 1 and 2	do	1,592	.19	None.	.19
Do	Dec. 15, 1915		5 A drain, schedules 1 and 2	do	1,649	.14	.25	.14
Do	do		5 A drain, schedule 3	do	530	.14	.20	.14
Do	do		1 I drain, schedules 1 and 2	do	1,233	.25	.375	[1].14
Do	May 24, 1916		C 4 E 1 lateral	do	1,425	.15	.16	.15
Do	do		A 4 B lateral	do	1,344	.175	.18	[2].175
Do	do		C 7 H lateral	do	377	.14	.19	.14
Do	June 5, 1916		D 12 lateral	do	1,405	.13	.15	[3].13
Do	do		D 15 lateral	do	2,331	.125	.135	[3].125
Do	do		D 17 A lateral	do	1,094	.125	.14	[3].125
Do	do		D 18 lateral, schedule 12	do	1,701	.123	.14	[3].125
Do	do		D 18 lateral, schedule 13	do	1,983	.11	.14	[3].110
Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1.	do	11,000	.17	.50	.17

Do	do	337	High Line Canal, division 10, laterals, schedule 2.	do	30,000	.18	.50	.18
Do	do	337	High Line Canal, division 10, laterals, schedule 3.	do	11,000	.18		.18
Wyoming, Shoshone	Oct. 20, 1915	317	Frannie division, schedule 1	do	140,000	.17	.18	.18
Do	do	317	Frannie division, schedule 2	do	184,000	.139	.15	.139
Do	do	317	Frannie division, schedule 3	do	192,000	.16	.16	.16

EXCAVATION, CLASS 2 (INDURATED MATERIAL).

California, Orland	Dec. 15, 1915		Relocation of South Canal, Division 1	Cubic yard	50	$0.40	(4)	$0.40
Do	do		Relocation of South Canal, Division 2	do	40	.40	(4)	.40
Do	do		Relocation of South Canal, Division 3	do	60	.35	$0.40	.40
Do	do		Relocation of South Canal, Division 4	do	60	.35	.40	.40
Do	do		Relocation of South Canal, Division 5	do	40	.35	.40	.40
Colorado, Grand Valley	Nov. 4, 1915	320	Main Canal, division 4, schedule 1	do	3,500	.25	.32	.25
Do	do	320	Main Canal, division 4, schedule 2	do	4,000	.25	.32	.25
Do	do	320	Main Canal, division 4, schedule 3	do	2,000	.25	.32	.25
Do	do	320	Main Canal, division 4, schedule 4	do	3,000	.25	.32	.25
Do	do	320	Main Canal, division 4, schedule 5	do	3,000	.25	.25	.25
Do	do	320	Main Canal, division 4, schedule 6	do	2,000	.25	.32	.25
Do	do	320	Main Canal, division 4, schedule 7	do	2,000	.25	.30	.25
Do	do	320	Main Canal, division 4, schedule 8	do	1,500	.25	.25	.25
Do	do	320	Laterals, second district, schedule 9	do	2,000	.115	.24	.115
Do	do	320	Laterals, second district, schedule 10	do	2,000	.11	.14	.20
Do	do	320	Laterals, second district, schedule 11	do	2,500	.11	.115	.11
Do	do	320	Laterals, second district, schedule 12	do	2,000	.24	.25	.25
Do	do	320	Laterals, second district, schedule 13	do	2,000	.19	.25	.19
Do	do	320	Laterals, second district, schedule 14	do	2,000	.105	.25	.105
Do	do	320	Laterals, second district, schedule 15	do	2,000	.10	.11	
Do	do	320	Laterals, second district, schedule 16	do	2,000	.12	.25	.12
Colorado, Uncompahgre Valley	Oct. 20, 1915	319	Ironstone Canal, schedule 1	do	6,500	.28½		.28½
Do	do	319	Ironstone Canal, schedule 2	do	12,200	.26½		.26½
Do	do	319	Ironstone Canal, schedule 3	do	3,750	.16½		.16½
Do	do	319	Ironstone Canal, schedule 4	do	1,350	.16½		.16½
Do	do	319	Ironstone Canal, schedule 5	do	550	.16½		.16½
Do	Jan. 18, 1916	323	Peach Valley lateral, schedule 1	do	900	.17½	.17½	.17½
Do	do	323	Peach Valley lateral, schedule 2	do	1,100	.1599	.16	.1599
Do	do	323	Peach Valley lateral, schedule 3	do	1,400	.1599	.17½	.1599
Do	do	323	Peach Valley lateral, schedule 4	do	2,000	.17½	.18¼	.18¼
Do	do	323	Peach Valley lateral, schedule 5	do	1,800	.1599	.17½	.1599
Do	do	323	Peach Valley lateral, schedule 6	do	1,000	.1599	.16	.1599
Do	do	323	Peach Valley lateral, schedule 7	do	1,000	.20	.20¼	.20

[1] All bids rejected as too high. Contract made at lower rate.

[2] A bid of 16 cents, all schedules or none, was rejected because of that provision.

[3] A bid of 9 cents for all schedules or none was rejected because of that provision, because that time limit of 25 days for completion made it impossible.

[4] Only 1 bid received.

Unit bids and contract prices on formal specifications—Continued.

EXCAVATION, CLASS 2 (INDURATED MATERIAL)—Continued.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Montana, Flathead	June 30, 1915	F-2	Pablo Canals, laterals 7P and 8Z, schedule 1	Cubic yard	40	$0.30	$0.35	$0.35
Do	Aug. 18, 1915	308	Pablo lateral 31A	do	250	.25	.30	.30
Do	Oct. 12, 1915	318	Mission lateral H	do	400	.50	.85	.50
Do	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, R, schedule 1	do	75	.50	1.00	Rejected.
Do	Mar. 23, 1916	328	Mission division, schedule 4	do	50	.30	.30	.30
Do	do	328	Post division, schedule 5	do	200	.30	.30	.30
Do	do	328	Pablo division, schedule 6	do	50	.30	.30	.30
Do	Mar. 29, 1916	330	Jocko division, schedule 1	do	75	.40	.40	.40
Do	May 25, 1916	333	Pablo sublaterals 31A, schedule 1	do	2,000	.40	.50	.50
Do	do	333	Pablo laterals 70A and 71A, schedule 3	do	5,000	.40	.40	.40
Do	May 26, 1916	F-3	Pablo division, By-Pass Canal	do	20	.50	.50	.50
Montana, Milk River	Aug. 12, 1915	309	Nelson Reservoir South Canal, schedule 1	do	500	.35	.50	.35
Do	do	309	Nelson Reservoir South Canal, schedule 2	do	500	.20	.35	.35
Do	do	309	Nelson Reservoir South Canal, schedule 3	do	500	.35	.40	.40
Do	Sept. 20, 1915	315	Bowdoin Canal, first unit, schedule 1	do	100	.154	.30	.40
Do	do	315	Bowdoin Canal, first unit, schedule 2	do	200	.25	.30	.40
Do	do	315	Bowdoin Canal, first unit, schedule 3	do	500	.30	.40	.30
Do	Mar. 15, 1916	327	Bowdoin Canal system, first-unit laterals and waste-water ditches.	do	100	.145	.40	.145
Nebraska-Wyoming, North Platte	May 27, 1916	Informal.	Schedule 1, Indian Creek Wasteway	do	200	.11	.30	.11
Do	Sept. 8, 1915	313	Fort Laramie Canal, division 1, schedule 1	do	18,200	.39	.40	.428
Do	do	313	Fort Laramie Canal, division 1, schedule 2	do	7,200	.156	.83	.156
Do	do	313	Fort Laramie Canal, division 1, schedule 3	do	2,200	.148	.25	.27
Do	do	313	Fort Laramie Canal, division 1, schedule 4	do	400	.13	.144	.13
Do	Mar. 10, 1916	326	Fort Laramie Canal, division 2, schedule 1	do	16,000	.209	.35	.209
Do	do	326	Fort Laramie Canal, division 2, schedule 2	do	8,000	.169	.85	.169
Do	do	326	Fort Laramie Canal, division 2, schedule 3	do	30,000	.20	.375	.225
Do	do	326	Fort Laramie Canal, division 2, schedule 4	do	8,000	.142	.15	.142
Do	May 25, 1916	336	Fort Laramie Canal, division 3, schedule 1	do	73,000	.174	.18	.19
Do	do	336	Fort Laramie Canal, division 3, schedule 2	do	200	.14	.174	.40
Do	do	336	Fort Laramie Canal, division 3, schedule 3	do	13,000	.14	.17	.14
Do	do	336	Fort Laramie Canal, division 3, schedule 4	do	24,000	.14	.174	.14
New Mexico-Texas, Rio Grande	Nov. 17, 1915	321	Leasburg Extension Canal, schedule 1	do	100	.140	.150	.200
Do	do	321	Leasburg Extension Canal, schedule 2	do	100	.140	.145	.200
Do	do	321	Leasburg Extension Canal, schedule 3	do	100	.140	.145	.200
Do	do	321	Leasburg Extension Canal, schedule 4	do	.100	.145	.145	.200
Do	do	321	Leasburg Extension Canal, schedule 5	do	100	.140	.145	.200
Do	do	321	Picacho Branch Canal, schedule 6	do	10	.150	.155	.200
Do	do	321	Picacho Branch Canal, schedule 7	do	10	.150	.160	.200

Do	do	321	San Elizario Feed Canal, schedule 8	do	100	.140	.180	.200
Do	do	321	San Elizario Feed Canal, schedule 9	do	100	.140	.180	.140
Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1.	do	2,800	.28	.50	.28
Do	do	337	High Line Canal, division 10, laterals, schedule 2.	do	4,700	.30	.50	.30
Do	do	337	High Line Canal, division 10, laterals, schedule 3.	do	6,500	.30		.30
Wyoming, Shoshone	Oct. 20, 1915	317	Frannie division, schedule 1	do	8,500	.50	.50	.50
Do	do	317	Frannie division, schedule 2	do	1,000	.50	.50	.50
Do	do	317	Frannie division, schedule 3	do	500	.50	.50	.50

EXCAVATION, CLASS 3 (ROCK).

California, Orland	Dec. 15, 1915		Relocation of South Canal, division 1	Cubic yard	5	$1.00	(1)	$1.00
Do	do		Relocation of South Canal, division 2	do	5	1.00	(1)	1.00
Do	do		Relocation of South Canal, division 3	do	5	.40	$1.00	1.00
Do	do		Relocation of South Canal, division 4	do	5	.40	1.00	1.00
Do	do		Relocation of South Canal, division 5	do	5	.40	1.00	1.00
Colorado, Grand Valley	Nov. 4, 1915	320	Main Canal, division 4, schedule 1	do	100	.40	.60	.60
Do	do	320	Main Canal, division 4, schedule 2	do	100	.40	.60	.60
Do	do	320	Main Canal, division 4, schedule 3	do	100	.40	.60	.60
Do	do	320	Main Canal, division 4, schedule 4	do	100	.40	.60	.60
Do	do	320	Main Canal, division 4, schedule 5	do	100	.40	.60	.60
Do	do	320	Main Canal, division 4, schedule 6	do	100	.40	.60	.60
Do	do	320	Main Canal, division 4, schedule 7	do	100	.40	.60	.60
Do	do	320	Main Canal, division 4, schedule 8	do	100	.40	.60	.60
Do	do	320	Laterals, second district, schedule 9	do	10	.115	.24	.115
Do	do	320	Laterals, second district, schedule 10	do	10	.11	.11	.50
Do	do	320	Laterals, second district, schedule 11	do	40	.10	.115	.10
Do	do	320	Laterals, second district, schedule 12	do	50	.24	.60	.60
Do	do	320	Laterals, second district, schedule 13	do	[illegible]	.19	.60	.19
Do	do	320	Laterals, second district, schedule 14	do	40	.105	.60	.105
Do	do	320	Laterals, second district, schedule 15	do	10	.10	.10	
Do	do	320	Laterals, second district, schedule 16	do	10	.12	.50	.12
Colorado, Uncompahgre Valley	Oct. 20, 1915	319	Ironstone Canal, schedule 1	do	4,000	.28½		.28½
Do	do	319	Ironstone Canal, schedule 2	do	4,600	.26½		.26½
Do	Jan. 18, 1916	323	Peach Valley lateral, schedule 1	do	100	.17½	.17½	.17½
Do	do	323	Peach Valley lateral, schedule 2	do	100	.1599	.16	.1599
Do	do	323	Peach Valley lateral, schedule 3	do	300	.1599	.17½	.1599
Do	do	323	Peach Valley lateral, schedule 4	do	500	.17½	.18½	.18½
Do	do	323	Peach Valley lateral, schedule 5	do	400	.1599	.17½	.1599
Do	do	323	Peach Valley lateral, schedule 6	do	200	.1599	.16	.1599
Do	do	323	Peach Valley lateral, schedule 7	do	200	.20½	.50	.59
Montana, Flathead	June 30, 1915	F2	Pablo laterals 7P and 8Z, schedule 1	do	10	.60	.80	.80
Do	Aug. 18, 1915	308	Pablo lateral 31A, schedule 1	do	50	.50	1.00	1.50
Do	Oct. 12, 1915	318	Mission lateral H, schedule 1	do	100	1.00	2.50	1.00
Do	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, R, schedule 1	do	25	1.25	1.50	Rejected.

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[1] Only 1 bid received.

Unit bids and contract prices on formal specifications—Continued.

EXCAVATION. CLASS 3 (ROCK)—Coontinued.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Montana, Flathead	Mar. 23, 1916	328	Mission division, schedule 4	Cubic yard	25	$0.60	$0.60	$0.60
Do	do	328	Post division, schedule 5	do	50	.60	.60	.60
Do	do	328	Pablo division, schedule 6	do	25	.60	.60	.60
Do	Mar. 29, 1916	330	Jocko division, schedule 1	do	25	1.00	1.00	1.00
Do	May 25, 1916	333	Pablo division, sub-laterals 31A, schedule 1	do	500	.90	1.00	1.00
Do	do	333	Pablo laterals 70A and 71 A, schedule 3	do	5,000	.90	.90	.90
Do	May 26, 1916	F3	Pablo division, By Pass Canal	do	20	1.50	1.50	1.50
Montana, Milk River	Aug. 12, 1915	309	Nelson Reservoir South Canal, schedule 1	do	50	.70	.75	.75
Do	do	309	Nelson Reservoir South Canal, schedule 2	do	50	.40	.70	.75
Do	do	309	Nelson Reservoir South Canal, schedule 3	do	50	.70	.75	1.00
Do	Sept. 20, 1915	315	Bowdoin Canal, first unit, schedule 1	do	10	.75	1.00	1.25
Do	do	315	Bowdoin Canal, first unit, schedule 2	do	100	.75	1.00	1.25
Do	do	315	Bowdoin Canal, first unit, schedule 3	do	100	.75	1.00	.75
Do	Mar. 15, 1916	327	Bowdoin Canal system, first unit laterals and waste-water ditches.	do	10	.145	1.25	.145
Nebraska-Wyoming, North Platte	Sept. 8, 1915	313	Fort Laramie Canal, division 1, schedule 1	do	7,200	.428	.71	.428
Do	do	313	Fort Laramie Canal, division 1, schedule 2	do	8,700	.156	.55	.156
Do	do	313	Fort Laramie Canal, division 1, schedule 3	do	2,700	.148	.50	.58
Do	do	313	Fort Laramie Canal, division 1, schedule 4	do	400	.13	.144	.13
Do	Mar. 10, 1916	326	Fort Laramie Canal, division 2, schedule 1	do	33,000	.209	.43	.209
Do	do	326	Fort Laramie Canal, division 2, schedule 2	do	17,000	.169	.43	.169
Do	do	326	Fort Laramie Canal, division 2, schedule 3	do	59,000	.225	.43	.225
Do	do	326	Fort Laramie Canal, division 2, schedule 4	do	2,000	.142	.187	.142
Do	May 25, 1916	336	Fort Laramie Canal, division 3, schedule 1	do	500	.174	.19	.19
Do	do	336	Fort Laramie Canal, division 3, schedule 2	do	200	.14	.174	.50
Do	do	336	Fort Laramie Canal, division 3, schedule 3	do	200	.17	.174	.80
Do	do	336	Fort Laramie Canal, division 3, schedule 4	do	200	.174	.18	.80
New Mexico-Texas, Rio Grande	Nov. 17, 1915	321	Leasburg Extension Canal, schedule 1	do	10	.150	.150	.200
Do	do	321	Leasburg Extension Canal, schedule 2	do	10	.145	.150	.200
Do	do	321	Leasburg Extension Canal, schedule 3	do	10	.145	.150	.200
Do	do	321	Leasburg Extention Canal, schedule 4	do	10	.145	.150	.200
Do	do	321	Leasburg Extension Canal, schedule 5	do	10	.145	.150	.200
Do	do	321	Picacho Branch Canal, schedule 6	do	10	.150	.155	.200
Do	do	321	Picacho Branch Canal, schedule 7	do	10	.150	.160	.200
Do	do	321	San Elizario Feeder Canal, sche[illegible]	do	10	.150	.180	.300
Do	do	321	San Elizario Feeder Canal, s[illegible]edule 8	do	10	.150	.180	.200
Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, divisi[illegible] schedule 9 [illegible]on 10, laterals, schedule 1.	do	1,200	1.25	2.00	1.25

Utah, Strawberry Valley	do	337	High Line Canal, division 10, laterals, schedule 2.	do	1,300	$1.25	$1.50	$1.25
Do	do	337	High Line Canal, division 10, laterals, schedule 3.	do	1,000	1.25		1.25
Wyoming, Shoshone	Oct. 20, 1915	317	Frannie division, schedule 1	do	15,500	1.00	1.00	1.00
Do	do	317	Frannie division, schedule 2	do	1,000	.50	1.00	.50
Do	do	317	Frannie division, schedule 3	do	500	1.00	1.00	1.00

EXCAVATION, CLASS 3 (HARD SHALE).

Colorado, Grand Valley	Nov. 4, 1915	320	Main Canal, division 4, schedule 1	Cubic yard	1,000	$0.40	$0.40	$0.40
Do	do	320	Main Canal, division 4, schedule 2	do	1,200	.40	.40	.40
Do	do	320	Main Canal, division 4, schedule 3	do	500	.40	.40	.40
Do	do	320	Main Canal, division 4, schedule 4	do	1,000	.40	.40	.40
Do	do	320	Main Canal, division 4, schedule 5	do	1,000	.40	.50	.40
Do	do	320	Main Canal, division 4, schedule 6	do	600	.40	.40	.40
Do	do	320	Main Canal, division 4, schedule 7	do	500	.40	.55	.40
Do	do	320	Main Canal, division 4, schedule 8	do	400	.40	.43	.40
Do	do	320	Laterals, second district, schedule 9	do	500	.115	.24	.115
Do	do	320	Laterals, second district, schedule 10	do	100	.11	.13	.30
Do	do	320	Laterals, second district, schedule 11	do	200	.115	.12	.12
Do	do	320	Laterals, second district, schedule 12	do	300	.24	.40	.40
Do	do	320	Laterals, second district, schedule 13	do	200	.19	.40	.19
Do	do	320	Laterals, second district, schedule 14	do	200	.105	.40	.105
Do	do	320	Laterals, second district, schedule 15	do	100	.10	.12	
Do	do	320	Laterals, second district, schedule 16	do	100	.12	.35	.12

EXCAVATION—DRY.

Nebraska-Wyoming, North Platte	Mar. 10, 1916	325	Fort Laramie Canal, siphons, schedule 1	Cubic yard	1,600	$0.30	$0.375	$0.375
Do	do	325	Fort Laramie Canal, siphons, schedule 2	do	3,000	.30	.30	.30

EXCAVATION, STRUCTURES.

Montana, Flathead	June 30, 1915	F2	Pablo laterals 7P and 8Z, schedule 2, class 1	Cubic yard	500	$0.50	$0.60	$0.60
Do	do	F2	Pablo laterals 7P and 8Z, schedule 2, class 2	do	40	.70	.75	.75
Do	do	F2	Pablo laterals 7P and 8Z, schedule 2, class 3	do	5	1.25	1.50	1.25
Do	Aug. 18, 1915	308	Pablo laterals 31A, schedule 2, class 1	do	2,000	.35	.50	.35
Do	do	308	Pablo laterals 31A, schedule 2, class 2	do	100	.60	1.00	.60
Do	do	308	Pablo laterals, 31A, schedule 2, class 3	do	5	1.00	1.50	1.50
Do	do	308	Pablo laterals A and 73A, schedule 3, class 1	do	5,500	.35	.50	.35
Do	do	308	Pablo laterals A and 73A, schedule 3, class 2	do	300	.60	1.00	.60
Do	do	308	Pablo laterals A and 73A, schedule 3, class 3	do	5	1.00	1.50	1.50
Do	Oct. 12, 1915	318	Mission lateral H, schedule 2, class 1	do	2,700	.50	.60	.50

Unit bids and contract prices on formal specifications—Continued.

EXCAVATION, STRUCTURES—Continued.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Montana, Flathead	Oct. 12, 1915	318	Mission lateral H, schedule 2, class 2	Cubic yard	250	$0.75	$0.85	$0.75
Do	do	318	Mission lateral H, schedule 2, class 3	do	5	1.50	3.00	1.50
Do	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, R, schedule 2, class 1.	do	1,150	.50	1.00	Rejected.
Do	do	324	Jocko laterals E, J, L, M, N, R, schedule 2, class 2.	do	40	1.00	1.50	Rejected.
Do	do	324	Jocko laterals E, J, L, M, N, R, schedule 2, class 3.	do	10	1.50	2.00	Rejected.
Do	do	324	Jocko River crossing, schedule 3, class 1	do	156	.50	1.00	Rejected.
Do	do	324	Jocko River crossing, schedule 3, class 2	do	25	1.00	2.00	Rejected.
Do	do	324	Jocko River crossing, schedule 3, class 3	do	25	1.50	3.00	Rejected.
Do	Mar. 23, 1916	328	Mission division, schedule 1, class 1	do	115	.50	.50	.50
Do	do	328	Mission division, schedule 1, class 2	do	4	1.00	1.00	1.00
Do	do	328	Mission division, schedule 1, class 3	do	1	1.50	1.50	1.50
Do	do	328	Post division, schedule 2, class 1	do	2,150	.50	.50	.50
Do	do	328	Post division, schedule 2, class 2	do	45	1.00	1.00	1.00
Do	do	328	Post division, schedule 2, class 3	do	5	1.50	1.50	1.50
Do	do	328	Pablo division, schedule 3, class 1	do	520	.50	.50	.50
Do	do	328	Pablo division, schedule 3, class 2	do	20	1.00	1.00	1.00
Do	do	328	Pablo division, schedule 3, class 3	do	5	1.50	1.50	1.50
Do	Mar. 29, 1916	330	Jocko division, schedule 2, class 1	do	1,150	1.00	1.00	1.00
Do	do	330	Jocko division, schedule 2, class 2	do	40	1.00	1.00	1.00
Do	do	330	Jocko division, schedule 2, class 3	do	10	1.00	1.00	1.00
Do	May 25, 1916	333	Pablo 31A sublaterals, schedule 2, class 1	do	3,200	.50	1.00	.50
Do	do	333	Pablo 31A sublaterals, schedule 2, class 2	do	600	.75	1.00	.75
Do	do	333	Pablo 31A sublaterals, schedule 2, class 3	do	100	1.20	2.50	1.20
Do	do	333	Pablo laterals 70A and 71A, schedule 4, class 1	do	7,700	No bid.		
Do	do	333	Pablo laterals 70A and 71A, schedule 4, class 2	do	100	No bid.		
Do	do	333	Pablo laterals 70A and 71A, schedule 4, class 3	do	50	No bid.		
Montana, Milk River	Sept. 20, 1915	314	Nelson Reservoir South Canal	do	25,000	.40	.50	.40
Do	do	315	Bowdoin Canal, first unit	do	2,000	.25	.50	.25
Do	Apr. 25, 1916	[1] 327	Bowdoin Canal system, first unit	do	5,600	.38	.40	.40
Wyoming, Shoshone	May 3, 1916	331	Frannie division, class 1, material	do	3,000	.40	.40	.40
Do	do	331	Frannie division, class 2, material	do	700	.60	.75	.75
Do	do	331	Frannie division, class 3, material	do	1,000	1.00	1.25	1.25
Do	do	331	Frannie division, class 1, material	do	11,000	.40	.45	(2)
Do	do	331	Frannie division, class 2, material	do	100	.60	.75	(2)
Do	do	331	Frannie division, class 3, material	do	500	1.00	1.25	(2)

EXCAVATION, WET.

Nebraska-Wyoming, North Platte	Mar. 10, 1916	325	Fort Laramie Canal, siphons, schedule 1	Cubic yards	7,000	$1.60	$3.00	$1.60

FENCE, REBUILDING.

Montana, Flathead	Oct. 12, 1915	318	Mission lateral H	Rods	175	$0.50	$1.00	$0.50

FLUMES—ERECTION OF TIMBER SUBSTRUCTURE.

Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1.	M feet b. m.	20	$20.00	$50.00	$20.00
Do	do	337	High Line Canal, division 10, laterals, schedule 2.	do	10	20.00	45.00	20.00
Do	do	337	High Line Canal, division 10, laterals, schedule 3.	do	120	20.00		20.00

FLUMES, METAL (ERECTION).

Montana, Flathead	Oct. 12, 1915	318	Mission lateral H, schedule 2, 3 feet 2 inches diameter.	Linear feet	556	$0.30	$0.60	$0.90
Do	May 25, 1916	333	Pablo division, sublateral 31A, schedule 2, 3 feet 10 inches diameter.	do	310	.35	.50	.35
Montana, Milk River	Sept. 20, 1915	314	Nelson Reservoir South Canal, 375 linear feet of flume 6 feet 4½ inches in diameter and 75 linear feet of flume 3 feet 2 inches in diameter.	do	450	.30	.66	.30
Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1, 1 foot 11 inches diameter.	do	1,200	.15	.20	.15
Do	do	337	High Line Canal, division 10, laterals, schedule 1, 3 feet 2¼ inches diameter.	do	860	.20	.25	.20
Do	do	337	High Line Canal, division 10, laterals, schedule 2, 5 feet 8¾ inches diameter.	do	540	.25	.40	.25
Do	do	337	High Line Canal, division 10, laterals, schedule 3, 3 feet 2¼ inches diameter.	do	240	.20		.20
Do	do	337	High Line Canal, division 10, laterals, schedule 3, 4 feet 5¼ inches diameter.	do	9,140	.25		.25

[1] Reissue.

[2] Not awarded.

Unit bids and contract prices on formal specifications—Continued.

FOUNDATIONS, GRAVEL.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Wyoming, Shoshone	May 3, 1916	331	Frannie division, schedule 1	Cubic yard	200	$1.25	$1.84	$1.25
Do	do	331	Frannie division, schedule 2	do	200	2.15	3.75	(1)

GATE-LIFTING DEVICES.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Montana, Sun River	Nov. 8, 1915	6D	Schedule 2, item 1, single-speed, bevel-geared, ball-bearing pedestal stands, with stems for gates 3 feet by 3 feet 2 inches to 4 feet by 3 feet 6 inches.	Number	13	$670.16	$642.00 139.00	$670.16
Do			Schedule 2, item 2, base lifts gate stands with stems for 18 by 18 inches to 4 feet by 2 feet 6 inches.	do	13			

GATES, CAST-IRON, WITH LIFTING DEVICES.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Montana, Milk River	May 15, 1916	332	Item 1, 2 gates with opening 5 by 6 feet, 13,000 pounds.	Job		$1,681.00	$2,040.00	$1,681.00
Do	do	332	Item 2, 2 gates with opening 4 by 5 feet, 8,500 pounds.	do		1,170.00	1,372.00	1,170.00
Do	do	332	Item 3, 3 gates with opening 3½ by 4 feet and 1 with opening 4 by 4 feet, 6,900 pounds.	do		941.00	993.00	(2)

GATES, ERECTION, AND OTHER METAL WORK.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Montana, Flathead	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, R, metal work, schedule 2.	Pounds	14,000	$0.05	$0.06	(3)
Do	Mar. 29, 1916	330	Jocko division, schedule 2, metal work	do	14,000	.05	.05	$0.05

GATES (STEEL CREST FOR DAM, WITH OPERATING EQUIPMENT AND BRIDGE).

Montana, Milk River	Sept. 8, 1915	311	Vandalia Diversion Dam, 100-foot, low truss, riveted steel bridge spans, estimated total weight 211,520 pounds.	Span	3	$2,112.50	$2,317.00	$2,112.50
Do	do	311	3 sets movable crest gates, each set consisting of 5 gates of structural steel.	Pounds	70,500	.0323	.0325	.0325
Do	do	311	Pairs cast-iron pier plates, estimated total weight 6,000 to 9,000 pounds.	Pair	3	67.00	110.00	180.00
Do	do	311	Erection of bridge and movable crest gates complete.	Job		4,200.00	4,675.00	4,200.00
Do	do	311	Sets hoisting machinery and operating equipment.	Set	3	4,883.00	5,433.67	5,433.67
Do	do	311	Erection of hoisting machinery and operating equipment.	Job		3,000.00	3,840.00	3,000.00

GATES, STRUCTURAL STEEL, AND FRAMES.

Montana, Milk River, St. Mary storage.	July 9, 1915	307	Slide-gate structures for reservoir outlets; weight, 160 pounds.	Lump sum	1 set.	$3,815.50		$3,815.50
Do	July 19, 1915	310	Cylinder gates, complete set; weight:					
			104,145 pounds, cast in steel	Pounds		.0536		.0536
			2,780 pounds, bronze	do		.43		.43
Do	Aug. 18, 1915	1D	Bases and brackets for gate stems	do	20,000	.04		.04
Do	Aug. 25, 1915	2D	Shafts for cylinder gates	do	28,000	.05		.05
Do	Sept. 28, 1915	3D	Stems, stem guides, and couplings for slide gates; weight, 36,700 pounds.	Lump sum	1 set.	2,114.00		2,114.00
Do	Oct. 20, 1915	F7	Operating mechanism for cylinder gates	do	1 set.	731.50		731.50
Do	Nov. 5, 1915	F9	Hydraulic operating mechanism for slide gates; weight, 29,500 pounds.	do	1 set.	2,985.00		2,985.00
Montana, Sun River	Nov. 8, 1915	6D	Schedule 1, item 1, opening 3 feet by 3 feet 2 inches to 4 feet by 3 feet 6 inches.	Number	13	269.00	$274.00	274.00
Do	do	6D	Schedule 1, item 2, opening 18 inches by 18 inches to 4 feet by 2 feet 6 inches.	do	13	188.00	214.00	214.00
Do	do	6D	Schedule 1, item 3, opening 12 inches by 8 feet 3½ inches to 24 inches by 4 feet 7⅝ inches.	do	313	1,785.00	2,119.00	1,785.00

GATES, STRUCTURAL STEEL, WITH LIFTING DEVICES.

Montana, Milk River	May 15, 1916	332	Item 3A, 3 gates with opening 3½ by 4 feet and 1 with opening 4 by 4 feet, 5,000 pounds.	Job		$772.00	$970.00	$772.00
Do	do	332	Item 4A, 72 gates with openings from 3 by 4 feet to 1½ by 1½ feet, 22,500 pounds.	do		2,645.00	3,070.00	2,645.00
Do	do	332	Item 5, 27 gates for automatic spillway, sizes from 4 by 4 feet to 5 by 5½ feet, 13,000 pounds.	do		748.00	1,030.00	748.00

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[1] Not awarded.

[2] This item not awarded.

[3] Rejected.

Unit bids and contract prices on formal specifications—Continued.

GRAVEL, SCREENED.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Montana, Flathead	May 25, 1916	333	Pablo division, sublateral 31A, schedule 2	Cubic yard	10	$3.00	$5.00	$5.00
Do	do	333	Pablo laterals 70A and 71A, schedule 4	do	25	(1)		

LUMBER, BUILDING.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Lowest.	Next.	Contract price.
Wyoming, Shoshone	May 5, 1916	331	Frannie division, schedule 1	M feet b. m	20	$20.00	$20.00	$20.00
Do	do	331	Frannie division, schedule 2	do	100	18.00	20.00	(2)

LUMBER, PLACING.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Lowest.	Next.	Contract price.
Montana, Flathead	Aug. 18, 1915	308	Pablo laterals A and 73A, schedule 3	M feet b. m	53	$24.00	$27.00	$27.00
Do	do	308	Pablo lateral 31A, schedule 2	do	21	22.00	22.00	28.00
Do	Oct. 12, 1915	318	Mission lateral H, wooden structures, schedule 2.	do	32	30.00	32.30	41.00
Do	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, R, schedule 2	do	16	20.00	24.00	(3)
Do	Mar. 29, 1916	330	Jocko division, structures	do	16	22.00	22.00	22.00
Do	May 25, 1916	333	Pablo division, flume	do	36	38.00	63.00	38.00
Montana, Milk River	Sept 20, 1915	314	Nelson Reservoir, South Canal structures	do	85	12.00	16.00	12.00
Do	do	315	Bowdoin Canal, first unit structures	do	12	11.00	12.00	11.00
Do	Apr. 25, 1916	[4]327	Bowdoin Canal system, first unit structures, for bridges.	do	28	12.00	17.00	18.00
Do	do	[4]327	Bowdoin Canal system, first unit structures, for turnouts, stop planks, etc.	do	22	18.50	20.00	20.00

OVERHAUL.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Lowest.	Next.	Contract price.
Colorado, Grand Valley	Nov. 4, 1915	320	Main Canal, division 4, schedule 1	Cubic yards	6,000	(5)	(5)	$0.02
Do	do	320	Main Canal, division 4, schedule 2	do	17,000	(5)	(5)	.02
Do	do	320	Main Canal, division 4, schedule 3	do	8,800	(5)	(5)	.02
Do	do	320	Main Canal, division 4, schedule 4	do	14,500	(5)	(5)	.02
Do	do	320	Main Canal, division 4, schedule 5	do	9,500	(5)	(5)	.02
Do	do	320	Main Canal, division 4, schedule 6	do	12,500	(5)	(5)	.02
Do	do	320	Main Canal, division 4, schedule 7	do	1,500	(5)	(5)	.02
Do	do	320	Main Canal, division 4, schedule 8	do	1,500	(5)	(5)	.02
Do	do	320	Laterals, second district, schedule 10	do	2,000	(5)	(5)	.02

Do	do	320	Laterals, second district, schedule 11	do	1,000	(5)	(5)	.02
Do	do	320	Laterals, second district, schedule 12	do	3,000	(5)	(5)	.02
Montana, Flathead	June 30, 1915	F2	Pablo laterals 7P and 8Z, schedule 1	Sta. yards	500	.02	.02	.02
Do	Aug. 18, 1915	308	Pablo lateral 31A, schedule 1	do	1,000	.02	.02	.02
Do	Oct. 12, 1915	318	Mission lateral H	do	1,000	.02	.02	.02
Do	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, R, schedule 1	do	100	.02	.02	(4)
Do	Mar. 23, 1916	328	Mission division, schedule 4	do	100	.02	.02	.02
Do	do	328	Post division, schedule 5	do	100	.02	.02	.02
Do	do	328	Pablo division, schedule 6	do	100	.02	.02	.02
Do	Mar. 29, 1916	330	Jocko division, schedule 1	do	100	.02	.02	.02
Do	May 25, 1916	333	Pablo division, 31A, sublaterals, schedule 1	do	10,000	.02	.02	.02
Do	do	333	Pablo laterals 70A and 71A, schedule 3	do	10,000	.02	.02	.02
Do	May 26, 1916	F3	Pablo division, by-pass canal, schedule 1	do	100	.02	.02	.02
Do	do	F3	Pablo division, by-pass canal, schedule 2	do	100	.02	.02	.02
Montana, Milk River	Aug. 12, 1915	309	Nelson Reservoir, South Canal	do	30,000			.02
Do	Sept. 20, 1915	314	Nelson Reservoir, South Canal, structures	do	2,500			.02
Do	do	315	Bowdoin Canal, first unit	do	34,000			.02
Do	Mar. 15, 1916	327	Bowdoin Canal system, first unit	do	5,000			.02
Nebraska-Wyoming, North Platte	Sept. 8, 1915	313	Fort Laramie Canal, division 1, schedule 1	Sta. cubic yards.	62,000			.02
Do	do	313	Fort Laramie Canal, division 1, schedule 2	do	17,000			.02
Do	do	313	Fort Laramie Canal, division 1, schedule 3	do	30,000			.02
Do	do	313	Fort Laramie Canal, division 1, schedule 4	do	5,300			.02
Do	Mar. 10, 1916	326	Fort Laramie Canal, division 2, schedule 1	do	1,000			.02
Do	do	326	Fort Laramie Canal, division 2, schedule 2	do	60,000			.02
Do	do	326	Fort Laramie Canal, division 2, schedule 3	do	16,000			.02
Do	do	326	Fort Laramie Canal, division 2, schedule 4	do	80,000			.02
Do	May 25, 1916	336	Fort Laramie Canal, division 3, schedule 1	do	35,000			.02
Do	do	336	Fort Laramie Canal, division 3, schedule 2	do	40,000			.02
Do	do	336	Fort Laramie Canal, division 3, schedule 3	do	100,000			.02
Do	do	336	Fort Laramie Canal, division 3, schedule 4	do	80,000			.02
New Mexico-Texas, Rio Grande	Nov. 17, 1915	321	Leasburg extension, schedule 1	Sta. yards	17,000	.015	.015	.020
Do	do	321	Leasburg extension, schedule 2	do	5,000	.015	.015	.020
Do	do	321	Leasburg extension, schedule 3	do	20,000	.015	.015	.020
Do	do	321	Leasburg extension, schedule 4	do	12,000	.015	.015	.020
Do	do	321	Leasburg extension, schedule 5	do	6,500	.015	.015	.020
Do	do	321	Picacho Branch Canal, schedule 6	do	10,000	.015	.020	.020
Do	do	321	Picacho Branch Canal, schedule 7	do	20,000	.015	.020	.020
Do	do	321	San Elizario Feed Canal, schedule 8	do	2,000	.005	.010	.010
Do	do	321	San Elizario Feed Canal, schedule 9	do	1,000	.005	.010	.010
Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1.	do	100			.02
Do	do	337	High Line Canal, division 10, laterals, schedule 2.	do	250			02
Do	do	337	High Line Canal, division 10, laterals, schedule 3.	do	150			.02
Wyoming, Shoshone	Oct. 20, 1915	317	Frannie division, schedule 1	do	77,000	.02	.02	.02
Do	do	317	Frannie division, schedule 2	do	25,000	.02	.02	.02
Do	do	317	Frannie division, schedule 3	do	40,000	.02	.02	.02

[1] No bid. [2] Not awarded. [4] Rejected. [3] Reissue. [5] Price fixed in schedule.

Unit bids and contract prices on formal specifications—Continued.

PAVING, DRY.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit. Lowest.	Bids per unit. Next.	Contract price.
Montana, Flathead	June 30, 1915	F2	Pablo laterals 7P and 8Z, schedule 2	Square yards	78	$1.95	$3.00	$1.95
Do	Aug. 18, 1915	308	Pablo lateral 31A, schedule 2	do	120	1.10	1.75	1.10
Do	do	308	Pablo laterals A and 73A, schedule 3	do	620	1.10	2.50	1.10
Do	Oct. 12, 1915	318	Mission lateral H	do	225	.95	1.90	1.90
Do	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, R, schedule 2	do	840	1.00	1.55	(1)
Do	Mar. 23, 1916	328	Mission division, schedule 1	do	20	1.85	1.85	1.85
Do	do	328	Post division, schedule 2	do	385	1.85	1.85	1.85
Do	do	328	Pablo division, schedule 3	do	95	1.85	1.85	1.85
Do	Mar. 29, 1916	330	Jocko division, schedule 2	do	840	1.40	1.40	1.40
Do	May 25, 1916	333	Pablo division, 31A sublaterals, schedule 2, 12-inch.	do	550	1.00	1.35	1.35
Do	do	333	Pablo division, 31A sublaterals, schedule 2, 18-inch.	do	50	1.65	2.00	1.65
Do	do	333	Pablo laterals 70A and 71A, schedule 4, 12-inch.	do	1,200	(2)	....	....
Do	do	333	Pablo laterals 70A and 71A, schedule 4, 18-inch.	do	100	(2)	....	....
Montana, Milk River	Sept. 20, 1915	314	Nelson Reservoir South Canal structures	do	3,000	1.55	1.60	1.55
Do	do	315	Bowdoin Canal, first-unit structures	do	420	1.60	1.75	1.75
Do	Apr. 25, 1916	[3] 327	Bowdoin Canal system, first-unit structures	do	520	1.75	2.00	2.00
Nebraska-Wyoming, North Platte	Mar. 10, 1916	325	Fort Laramie Canal, siphons, 18-inch	do	2,900	1.48	2.00	1.48
Do	do	325	Fort Laramie Canal, culverts, 18-inch	do	1,200	1.50	2.00	2.00
Do	May 22, 1916	334	Fort Laramie Canal, tunnel approaches, 18-inch.	do	500	1.50	2.00	2.00
Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1.	do	10	1.50	3.50	1.50
Do	do	337	High Line Canal, division 10, laterals, schedule 2.	do	10	1.50	2.00	1.50
Do	do	337	High Line Canal, division 10, laterals, schedule 3.	do	10	1.50	....	1.50
Wyoming, Shoshone	May 3, 1916	331	Frannie division, schedule 1	do	200	1.25	1.43	1.25
Do	do	331	Frannie division, schedule 2	do	300	1.50	2.50	(4)

PAVING, GROUTED.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit. Lowest.	Bids per unit. Next.	Contract price.
Montana, Flathead	June 30, 1915	F2	Pablo laterals 7P and 8Z, schedule 2	Square yards	58	$2.40	$3.90	$2.40
Do	Aug. 18, 1915	308	Pablo lateral 31A, schedule 2	do	290	1.86	2.00	1.86
Do	do	308	Pablo laterals A and 73A, schedule 3	do	840	1.86	2.75	1.86

Do	Oct. 12, 1915	318	Mission lateral H	do	185	1.81	2.30	2.30
Do	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, R, schedule 2	do	55	2.00	2.00	(1)
Do	do	324	Jocko River crossing, schedule 3	do	15	1.75	2.00	(1)
Do	Mar. 29, 1916	330	Jocko division, schedule 2	do	55	1.80	1.80	1.80
Do	May 25, 1916	333	Pablo division, 31A sublaterals, schedule 2	do	95	1.75	2.00	2.00
Do	do	333	Pablo division, laterals 70A and 71A, schedule 4.	do	1,260	(2)	....	....
Montana, Milk River	Apr. 25, 1916	[3] 327	Bowdoin Canal system, first-unit structures, rubble-concrete paving.	do	200	1.95	2.50	2.50
Nebraska-Wyoming, North Platte	Mar. 10, 1916	325	Fort Laramie Canal, siphons, 14-inch	do	1,000	1.80	2.25	1.80
Do	do	325	Fort Laramie Canal, culverts, 14-inch	do	900	1.80	2.25	2.50
Do	May 22, 1916	334	Fort Laramie Canal, tunnel approaches, 14-inch.	do	500	1.75	2.50	2.50
Wyoming, Shoshone	May 3, 1916	331	Frannie division, schedule 1, 9-inch	do	200	1.25	1.84	1.25
Do	do	331	Frannie division, schedule 2, 9-inch	do	4,000	2.26	2.70	(4)
Do	do	331	Frannie division, schedule 1, 12-inch	do	200	1.90	1.90	1.90
Do	do	331	Frannie division, schedule 2, 12-inch	do	500	2.35	3.00	(4)

PAVING, RUBBLE CONCRETE.

Montana, Flathead	June 30, 1915	F2	Pablo laterals 7P and 8Z, schedule 2	Square yards	28	$4.20	$4.50	$4.20
Do	Aug. 18, 1915	308	Pablo lateral 31A, schedule 2	do	160	3.00	4.15	3.00
Do	do	308	Pablo laterals A and 73A, schedule 3	do	1,500	3.00	3.00	3.00
Do	Oct. 12, 1915	318	Mission lateral H	do	20	2.95	3.50	3.50

PIPE, CAST-IRON, LAYING.

Wyoming, Shoshone	May 3, 1916	331	Frannie division, schedule 2, 12-inch	Linear feet	72	$0.30	$1.50	(4)
Do	do	331	Frannie division, schedule 2, 18-inch	do	44	.45	1.70	(4)
Do	do	331	Frannie division, schedule 2, 24-inch	do	40	.60	1.90	(4)
Do	do	331	Frannie division, schedule 2, 36-inch	do	80	.90	2.25	(4)

PIPE, CONCRETE AND VITRIFIED, LAYING.

Montana, Flathead	June 30, 1915	F2	Pablo laterals 7P and 8Z, 12-inch, concrete	Linear feet	56	$0.35	$0.95	$0.95
Do	do	F2	Pablo laterals 7P and 8Z, 24-inch, concrete	do	76	.50	1.60	1.60
Do	Oct. 12, 1915	318	Mission lateral H, 12-inch, vitrified	do	470	.87	.40	.60
Do	do	318	Mission lateral H, 18-inch, vitrified	do	200	.44	.50	1.00
Do	do	318	Mission lateral H, 24-inch, vitrified	do	540	.60	.78	1.80
Do	do	318	Mission lateral H, 24-inch, steel	do	425	.53	.75	1.10
Do	Mar. 23, 1916	328	Mission division, schedule 1, 15-inch, vitrified	do	170	.50	.50	.50
Do	do	328	Post division, schedule 2, 15-inch, vitrified	do	2,300	.50	.50	.50

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[1] Rejected. [2] No bids. [3] Reissue. [4] Not awarded.

Unit bids and contract prices on formal specifications—Continued.

PIPE, CONCRETE AND VITRIFIED, LAYING—Continued.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Montana, Flathead	Mar. 23, 1816	328	Pablo division, schedule 3, 15-inch, vitrified	Linear feet	515	$0.50	$0.50	$0.50
Do	Mar. 29, 1916	330	Jocko division, schedule 2, 12-inch, vitrified	do	1,025	.30	.30	.30
Do	do	330	Jocko division, schedule 2, 18-inch, vitrified	do	165	.50	.50	.50
Do	do	330	Jocko division, schedule 2, 24-inch, vitrified	do	130	.70	.70	.70
Do	do	330	Jocko division, schedule 2, 30-inch, vitrified	do	16	1.00	1.00	1.00
Do	May 25, 1916	333	Pablo 31A sublaterals, schedule 2, 6-inch, vitrified.	do	120	.23	.30	.30
Montana, Milk River	Sept. 20, 1915	314	Nelson Reservoir South Canal structures, 15-inch, vitrified.	do	150	.40	.66	.40
Do	Apr. 25, 1916	[1] 327	Bowdoin Canal, first-unit structures, 15 and 18 inch, vitrified.	do	920	.45	.48	.45
Do	do	[1] 327	Bowdoin Canal, first-unit structures, 24-inch, vitrified.	do	320	.60	.75	.60
Wyoming, Shoshone	May 3, 1916	331	Frannie division, schedule 1, 6-inch	do	1,500	.15	.15	.15
Do	do	331	Frannie division, schedule 2, 6-inch	do	1,700	.15	.17	(2)
Do	do	331	Frannie division, schedule 2, 12-inch	do	700	.15	.17	(2)
Do	do	331	Frannie division, schedule 1, 15-inch	do	50	.20	.20	.30
Do	do	331	Frannie division, schedule 1, 18-inch	do	82	.25	.30	.38
Do	do	331	Frannie division, schedule 2, 18-inch	do	940	.25	.38	(2)
Do	do	331	Frannie division, schedule 1, 24-inch	do	380	.30	.50	.50
Do	do	331	Frannie division, schedule 2, 24-inch	do	1,150	.30	.50	(2)
Do	do	331	Frannie division, schedule 1, 30-inch	do	160	.45	.65	.65
Do	do	331	Frannie division, schedule 2, 30-inch	do	370	.45	.65	(2)
Do	do	331	Frannie division, schedule 1, 33-inch	do	168	.60	.85	.85
Do	do	331	Frannie division, schedule 2, 33-inch	do	410	.60	.85	(2)
Do	do	331	Frannie division, schedule 2, 36-inch	do	108	.70	1.10	(2)

PIPE, CONCRETE, MANUFACTURING AND LAYING.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Lowest.	Next.	Contract price.
Montana, Flathead	Aug. 18, 1915	308	Pablo lateral 31A, schedule 2, 12-inch	Linear feet	47	$0.80	$0.85	$0.85
Do	do	308	Pablo lateral 31A, schedule 2, 30-inch	do	44	3.61	4.00	3.61
Do	do	308	Pablo laterals A and 73A, schedule 3, 12-inch	do	212	.85	1.00	.85
Do	do	308	Pablo laterals A and 73A, schedule 3, 18-inch	do	354	1.30	1.33	1.33
Do	do	308	Pablo laterals A and 73A, schedule 3, 24-inch	do	310	1.50	1.80	1.80
Do	May 25, 1916	333	Pablo sublateral 31A, schedule 2, 12-inch	do	1,230	.85	1.05	.85
Do	do	333	Pablo sublateral 31A, schedule 2, 15-inch	do	730	1.05	1.30	1.05
Do	do	333	Pablo sublateral 31A, schedule 2, 18-inch	do	470	1.30	1.50	1.30

Do	do	333	Pablo sublateral 31A, schedule 2, 24-inch	do	220	1.60	1.90	1.60
Do	do	333	Pablo laterals 70A and 71A, schedule 4, 12-inch	do	1,500	(3)		
Do	do	333	Pablo laterals 70A and 71A, schedule 4, 15-inch	do	740	(3)		
Do	do	333	Pablo laterals 70A and 71A, schedule 4, 18-inch	do	1,100	(3)		
Do	do	333	Pablo laterals 70A and 71A, schedule 4, 24-inch	do	230	(3)		

PIPE, STEEL-RIVETED, FURNISHING.

Utah, Strawberry Valley	May 4, 1915	F2	High Line Canal, division 7, lateral 3, 30-inch diameter, 398 feet long, No. 1199.	Lump sum		$765,00	$800.00	$765.00

PIPE, STEEL-RIVETED, LAYING (14-INCH NO. 16 GAUGE.

Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1.	Linear feet	40	$0.25	$0.35	$0.25
Do	do	337	High Line Canal, division 10, laterals, schedule 2.	do	140	.25	.25	.25
Do	do	337	High Line Canal, division 10, laterals, schedule 3.	do	40	.25		.25

PIPE, VITRIFIED, LAYING.

Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1, 12-inch diameter.	Linear feet	25	$0.35	$0.35	$0.35
Do	do	337	High Line Canal, division 10, laterals, schedule 1, 18-inch diameter.	do	500	.50	.60	.60
Do	do	337	High Line Canal, division 10, laterals, schedule 1, 24-inch diameter.	do	500	.75	1.00	1.00
Do	do	337	High Line Canal, division 10, laterals, schedule 2, 12-inch diameter.	do	100	.25	.35	.35
Do	do	337	High Line Canal, division 10, laterals, schedule 2, 18-inch diameter.	do	1,200	.35	.60	.60
Do	do	337	High Line Canal, division 10, laterals, schedule 2, 24-inch diameter.	do	200	.60	1.00	1.00
Do	do	337	High Line Canal, division 10, laterals, schedule 3, 12-inch diameter.	do	25	.35		.35
Do	do	337	High Line Canal, division 10, laterals, schedule 3, 18-inch diameter.	do	300	.60		.60
Do	do	337	High Line Canal, division 10, laterals, schedule 3, 24-inch diameter.	do	25	1.00		1.00

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[1] Not awarded.

[2] Reissue.

[3] No bids.

Unit bids and contract prices on formal specifications—Continued.

PIPE, WOOD-STAVE, FURNISHED AND ERECTED.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Colorado, Grand Valley	May 23, 1916	335	Item 1, 60-inch diameter, Douglas fir, painted, schedule 1.	Linear feet	3,950	$4.41	$4.48	....
Do	do	335	Item 1, 60-inch diameter, Redwood, unpainted, schedule 2.	do	3,950	5.00	5.56	$5.00
Do	do	335	Item 2, 6-inch blow-off valve with saddle	Each	1	54.50	60.00	60.00
Do	do	335	Item 2, 660 timber supports for 60-inch pipe	Total	1	1,031.00	1,396.00	1,031.00

PIPE, WOOD-STAVE, FURNISHED, ERECTED, AND PAINTED.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Lowest.	Next.	Contract price.
Montana, Sun River	May 5, 1916	[1] 329	96-inch diameter, Douglas fir, painted	Linear feet	575	$12.63	$12.98	....
Do	do	....	96-inch diameter, redwood, not painted	do	575	13.50	....	$13.50
Do	do	....	8-inch blow-off valve	Each	1	55.00	79.00	55.00

PUDDLING.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Lowest.	Next.	Contract price.
Montana, Flathead	June 30, 1915	F2	Pablo laterals 7P and 8Z, schedule 2	Cubic yards	50	$0.50	$0.75	$0.75
Do	Aug. 18, 1915	306	Pablo lateral 31A, schedule 2	do	600	.40	.55	.40
Do	do	306	Pablo laterals A and 73A, schedule 3	do	1,200	.40	.60	.40
Do	Oct. 12, 1915	318	Mission lateral H	do	300	.40	.70	.70
Do	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, R, schedule 2	do	220	.35	.50	(2)
Do	do	324	Jocko River Crossing, schedule 3	do	10	.40	1.00	(2)
Do	Mar. 23, 1916	328	Mission division, schedule 1	do	10	.45	.45	.45
Do	do	328	Post division, schedule 2	do	220	.45	.45	.45
Do	do	328	Pablo division, schedule 3	do	55	.45	.45	.45
Do	Mar. 29, 1916	330	Jocko division, schedule 2	do	220	.40	.40	.40
Do	May 25, 1916	333	Pablo sublateral 31A, schedule 2	do	800	.60	.70	.60
Do	do	333	Pablo laterals 70A and 71A, schedule 4	do	1,250	(3)	....	....
Montana, Milk River	Sept. 20, 1915	314	Nelson Reservoir South Canal, structures	do	1,500	.60	.60	.60
Do	do	315	Bowdoin Canal, first-unit structures	do	800	.60	.75	.60
Do	Apr. 26, 1916	[1] 327	Bowdoin Canal system, first-unit structures	do	500	.50	.75	.75

PUMPS.

Montana, Milk River, St. Mary storage.	Mar. 8, 1916	F10	Pressure pump	Lump sum	1	$680.00		$680.00

RIPRAP, GRAVEL.

Montana, Flathead	May 25, 1916	333	Pablo sublateral 31A, schedule 2	Cubic yards	20	$3.00	$3.50	$3.50
Do	do	333	Pablo laterals 70A and 71A, schedule 4	do	25	(3)		

ROCK FILL.

Utah, Strawberry Valley	June 15, 1916	337	High-Line Canal, division 10, laterals, schedule 1.	Linear feet	10	$1.00	$2.50	$1.00
Do	do	337	High Line Canal, division 10, laterals, schedule 2.	do	10	1.00	1.50	1.00
Do	do	337	High Line Canal, division 10, laterals, schedule 3.	do	10	1.00		1.00

ROCK FILL (RIPRAP).

California, Orland	May 10, 1916		South Canal diversion weir	Cubic yards	1,200	$2.50	(4)	$2.50

STEEL, REINFORCING BARS, PLACING.

Montana, Flathead	June 30, 1915	F2	Pablo laterals 7P and 8Z	Pounds	2,500	$0.02	$0.03	$0.03
Do	Aug. 18, 1915	308	Pablo lateral 31A	do	8,400	.02	.03	.02
Do	do	308	Pablo laterals A and 73A	do	25,100	.02	.03	.02
Do	Oct. 12, 1915	318	Mission lateral H	do	9,800	.02	.03	.03
Do	Feb. 8, 1916	324	Jocko laterals E, J, L, M, N, and R, schedule 2	do	17,500	.025	.03	(2)
Do	do	324	Jocko River Crossing, schedule 3	do	3,000	.025	.04	(2)
Do	Mar. 23, 1916	328	Mission division, schedule 1	do	950	.025	.025	.025
Do	do	328	Post division, schedule 2	do	16,300	.025	.025	.025
Do	do	328	Pablo division, schedule 2	do	4,000	.025	.025	.025
Do	Mar. 29, 1916	330	Jocko division, schedule 2	do	17,500	.025	.025	.025
Do	May 25, 1916	333	Pablo 31A, sublaterals	do	27,000	.025	.03	.025
Do	do	333	Pablo laterals 70A and 71A	do	50,500	(3)		
Montana, Milk River	Sept. 20, 1915	314	Nelson Reservoir South Canal structures	do	115,000	.0132	.015	.015
Do	do	315	Bowdoin Canal, first-unit structures	do	30,000	.0132	.015	.015
Do	Apr. 25, 1916	[1] 327	Bowdoin Canal system, first-unit structures	do	17,000	.0175	.02	.0175

[1] Reissue.

[2] Rejected.

[3] No bids.

[4] Only one bid received.

Unit bids and contract prices on formal specifications—Continued.

STEEL, REINFORCING BARS, PLACING—Continued.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Utah, Strawberry Valley	June 15, 1916	337	High Line Canal, division 10, laterals, schedule 1.	Pounds	30,000	$0.015	$0.02	$0.015
Do	do	337	High Line Canal, division 10, laterals, schedule 2.	do	25,000	.015	.02	.015
Do	do	337	High Line Canal, division 10, laterals, schedule 3.	do	25,000	.015	....	.015
Wyoming, Shoshone	May 3, 1916	331	Frannie division, schedule 1	do	50,000	.0175	.02	.0175
Do	do	331	Frannie division, schedule 2	do	50,000	.0175	.02	(1)

STEEL, REINFORCING, PLACING.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Nebraska-Wyoming, North Platte	Mar. 10, 1916	325	Fort Laramie Canal, siphons	Pounds	200,000	$0.01	$0.012	$0.0135
Do	do	325	Fort Laramie Canal, culverts	do	111,000	.011	.0135	.015
Do	May 22, 1916	334	Fort Laramie Canal, tunnel approaches	do	163,000	.006	.012	.015

STEEL, STRUCTURAL, ERECTING.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Montana, Flathead	Aug. 18, 1916	308	Pablo laterals A and 73A, schedule 3	Pounds	210	$0.045	$0.05	$0.045
Do	Mar. 23, 1916	328	Mission division, schedule 1	do	1,900	.045	.045	.045
Do	do	328	Post division, schedule 2	do	21,800	.045	.045	.045
Do	do	328	Pablo division, schedule 3	do	4,400	.045	.045	.045
Montana, Milk River	Sept. 20, 1915	314	Nelson Reservoir South Canal structures	do	6,000	.02	.02	.02
Do	do	315	Bowdoin Canal, first unit structures	do	2,000	.02	.03	.02
Do	Apr. 25, 1916	[2] 327	Bowdoin Canal system, first unit structures	do	5,000	.015	.0175	.0175
Wyoming, Shoshone	May 3, 1916	331	Frannie division, schedule 1	do	2,000	.0175	.02	.0175
Do	do	331	Frannie division, schedule 2	do	500	.0175	.05	(1)

STEEL, STRUCTURAL, FURNISHING.

State and project.	Date opening bids.	Specification No.	Feature or description.	Unit.	Quantity.	Bids per unit.		Contract price.
						Lowest.	Next.	
Montana, Milk River	May 15, 1916	332	Item 6, steel stop-plank guides and accessories, 5,000 pounds.	Job	....	$274.00	$300.00	$274.00

STEEL, STRUCTURAL, PLACING.

Nebraska-Wyoming, North Platte	Mar. 10, 1916	325	Fort Laramie Canal, siphons	Pounds	2,000	$0.0125	$0.015	$0.0125

TELEPHONE LINE, ERECTING.

Montana, Milk River	June 24, 1916	(³)	Malta to Dodson Dam, setting poles, stringing wires, etc.	Miles	25	$55.00	$65.00	$55.00
Do	do	(³)	Malta to Dodson Dam, installing instruments.	Number	8	3.00	4.00	3.00

TUNNEL.

Nebraska-Wyoming, North Platte	May 22, 1916	334	Fort Laramie Canal, tunnel, excavation and trimming for approaches.	Cubic yards	2,250	$0.50	$0.50	$0.80
Do	do	334	Fort Laramie Canal, tunnel, excavation, full timbered.	Linear feet	400	• 22.70	26.25	26.25
Do	do	334	Fort Laramie Canal, tunnel, excavation, half timbered.	do	2,900	22.70	22.75	24.90
Do	do	334	Fort Laramie Canal, tunnel, excavation, rock.	do	600	20.00	25.50	25.50
Do	do	334	Fort Laramie Canal, tunnel, excavation, soft ground.	do	950	28.40	28.80	28.80
Do	do	334	Fort Laramie Canal, tunnel, timbering permanent.	M feet b. m.	625	34.00	34.00	44.00

WALL, DRY RUBBLE.

Montana, Flathead	May 25, 1916	333	Pablo division, sublaterals 31A, schedule 2.	Cubic yards	210	$4.00	$5.45	$4.00

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[1] Not awarded.

[2] Reissue.

[3] Awarded and executed by project office.

ENGINEERING DATA FOR PROJECTS ON COMPLETION.

Engineering data for projects when completed.

RESERVOIRS.

Projects.	Name.	Area.	Capacity.	Spillways.			
				Length.	Elevation above stream bed.	Capacity.	
						Normal.	Maximum.
		Acres.	*Acre-feet.*	*Feet.*	*Feet.*	*Sec.-ft.*	*Sec.-ft.*
Arizona: Salt River	Roosevelt	16,832	1,367,300	400	225		
California: Orland	East Park	1,850	51,000	415	88	8,000	12,000
Colorado: Uncompaghre Valley.	Taylor Park	2,260	106,000	(1)	(1)	(1)	(1)
Idaho:							
Boise	Deer Flat	9,835	177,640	None.			
Do	Arrowrock	2,860	250,000	402	247	15,000	40,000
Minidoka	Lake Walcott	11,350	[2]150,000	2,885	42	40,000	60,000
Do	Jackson Lake	25,530	789,000	160	41	7,500	13,000
Montana:							
Milk River	St. Mary Lakes	6,910	124,000	500	20	[3]500	20,000
Do	Sherburne Lakes	2,000	78,000	200	70	[3]200	8,000
Do	Nelson Reservoir	6,020	132,000	(4)	[4]35		
Do	Point of Rocks	180	830	740	8	[3]0	700
Do	Beaver Creek	5,800	60,000		39	[3]100	5,000
Sun River	Willow Creek	2,696	86,000	200	100	725	(1)
Do	Sun River Storage	3,540	269,000	580	321	14,000	46,000
Do	Pishkun Reservoir	1,542	45,700	Under control.			
Do	Muddy Creek	1,828	33,000		80	284	(1)
Do	Benton Lake	9,300	144,000	Under control.			
Nebraska-Wyoming: North Platte.	Pathfinder	22,700	1,070,000	605	184	40,000	
Do	Lake Alice	900	11,400	100	18	2,500	
Do	Lake Minatare	2,240	67,025	100	55	2,000	
Nevada: Truckee-Carson	Lake Tahoe	125,000	750,000	85	6		
Do	Alkali Flat	8,500	88,000	(1)	(1)		
Do	Lahontan	12,000	290,000	500	112		
New Mexico: Carlsbad	Avalon	970	6,200	1,026	21	86,000	
Do	McMillan	7,860	51,500	1,500	23.7-24.5	17,000	32,000
Hondo	Hondo	1,910	40,000	None.			
New Mexico-Texas: Rio Grande.	Elephant Butte	40,080	2,638,860	275	193	8,000	16,000
Oklahoma: Lawton	Lake Lawtonka	1,080	12,000	257	50	3,200	4,000
Oregon: Umatilla	Cold Springs	1,500	50,000	330	90	6,000	6,000
Oregon-California: Klamath.	Upper Klamath Lake	60,000	264,000	None.			
Do	Clear Lake	25,000	462,000	357	24	10,000	30,000
South Dakota: Belle Fourche.	Belle Fourche	8,010	203,770	314	100	2,000	2,000
Do	Nine Mile	150	2,500	20	20	(1)	(1)
Utah: Strawberry Valley	Strawberry Valley	8,370	250,000	58	61	500	2,000
Washington:							
Okanogan	Salmon Lake	200	2,600	None.			
Do	Conconully	460	13,000	180	55	4,500	16,000
Yakima	Bumping Lake	1,350	34,000	235	36		6,000
Do	Lake Clealum	4,680	501,000	420	112		18,000
Do	Lake Kachess	4,800	210,000	250	53		7,200
Do	Tieton (McAllister Meadows).	1,800	185,000	350	183		19,000
Do	Lake Keechelus	2,550	152,000	300	60		10,000
Do	Clear Creek	126	1,700	210	35		
Wyoming: Shoshone	Shoshone[5]	6,600	456,600	300	233		
Do	Ralston	200	2,100				
INDIAN PROJECTS (see note).							
Montana:							
Blackfeet	Two Medicine Lake	854	16,000	66	25½	[3]250	[3]6,000
Do	Spring Lake	1,400	29,000	50	45	[3]0	[3]900
Do	Four Horns	1,867	60,640	50	57	[3]0	[3]1,000
Flathead	Big Draw	901	9,330	100	25	200	500
Do	Dog Lake	160	3,200		[4]30		
Do	Dry Fork	250	2,000	250	25	500	1,500

[1] Undetermined.

[2] 53,500 acre-feet only available; above fixed crest of spillway.

[3] Average flow of stream on which reservoir is located.

[4] No spillways; drainage limited; elevation is that of water surface.

[5] Capacity to top of fixed crest, 456,000 acre-feet; flashboards, 2 feet; increased storage, about 14,000 acre-feet.

Engineering data for projects when completed—Continued.

RESERVOIRS—Continued.

Projects.	Name.	Area.	Capacity.	Spillways.			
				Length.	Elevation above stream bed.	Capacity.	
						Normal.	Maximum.
INDIAN PROJECTS (see note)—continued.							
Montana—Continued.		*Acres.*	*Acre-feet.*	*Feet.*	*Feet.*	*Sec.-ft.*	*Sec.-ft.*
Flathead	Flathead Lake	107,000	1,800,000	1,000	180	100,000	150,000
Do	Horte	73	260	40	17	140	300
Do	Hubbart	400	15,000	50	120	400	1,200
Do	Kickinghorse	675	6,800		[1] 23		
Do	Little Bitter Root Lake	3,000	9,000		[1] 3		
Do	Lower Crow Creek	300	9,485	100	82	600	1,500
Do	McConnell	100	2,000		[1] 40		
Do	McDonald Lake	220	10,600	200	51	3,000	6,000
Do	Mission	300	8,300	100	74	1,200	3,000
Do	Nine Pipe	1,630	15,100		[1] 30		
Do	Pablo	2,100	29,600		[1] 36		
Do	Polson	70	1,700		[1] 80		
Do	St. Marys Lake	300	25,000	50	52	400	1,200
Do	Twin	70	937		[1] 25		
Fort Peck	Little Porcupine	390	3,900				
Do	Big Porcupine	750	9,400	([2])			
Do	Poplar River	3,700	50,000	([2])			
Do	Wolf Creek	350	4,550	([2])			
Do	Smoke Creek	300	5,300	([2])			
Total		586,529	13,805,827				

NOTE.—The Indian projects are separately classified, because they are not constructed under the terms of the reclamation law, but in each case are authorized by specified statute in connection with the appropriation for the Indian Office.

STORAGE DAMS.

Projects.	Name.	Type.	Maximum height.	Crest length.	Volume.
			Feet.	*Feet.*	*Cubic yds.*
Arizona: Salt River	Roosevelt [3]	Rubble masonry arch, gravity.	280	1,125	342,325
California: Orland	East Park [3]	Concrete arch, gravity	139	250	12,200
Colorado: Uncompahgre Valley.	Taylor Park	Undetermined	([4])	([4])	([4])
Idaho:					
Boise	Upper Deer Flat	Earth fill	70	4,900	1,190,275
Do	Lower Deer Flat [3]	do	40	7,200	1,207,606
Do	Deer Flat Forest	do	16	950	22,500
Do	Arrowrock [3]	Rubble concrete arch, gravity.	349	1,100	585,130
Minidoka	Minidoka [3]	Rockfill, concrete core	86	937	242,500
Do	Jackson Lake [5]	Massive concrete gate section and earth fill.	67	5,000	341,260
Montana:					
Milk River	St. Mary Lakes	Earth embankment	30	2,000	135,000
Do	Sherburne Lakes [5]	do	78	2,000	215,000
Do	Nelson Reservoir [6]	do	39	20,730	1,016,000
Do	Point of Rocks [3]	do	12.5	2,680	31,000
Do	Beaver Creek	do	49	8,000	500,000
Sun River	Willow Creek [7]	Earth fill	110	1,045	452,000
Do	Sun River Storage	Masonry	329	989	296,050
Do	Pishkun	Earth fill	48	8,600	444,000
Do	Muddy Creek	do	90	800	440,000
Do	Benton Lake	do	40	240	12,000
Nebraska-Wyoming: North Platte.	Pathfinder [3]	Broken range masonry arch	218	432	60,210
Do	Pathfinder Dike [3]	Earth fill	40	1,650	152,000
Do	Dam No. 1 [3]	do	30	3,100	240,000
Do	Dam No. 1½ [3]	do	23	2,550	119,000
Do	Minatare [3]	do	65	3,700	570,000

[1] No spillways; drainage limited; elevation is that of water surface.
[2] Undetermined.
[3] Completed.
[4] Not designed.
[5] Under construction.
[6] Completed to height of 11 feet, with storage of 25,000 acre-feet.
[7] Completed to height of 70 feet.

Engineering data for projects when completed—Continued.

STORAGE DAMS—Continued.

Projects.	Name.	Type.	Maximum height.	Crest length.	Volume.
			Feet.	*Feet.*	*Cubic yds.*
Nevada: Truckee-Carson.	Lake Tahoe [1]	Concrete sluiceway regulator.	14	109	425
Do.	Alkali Flat	Not designed			
Do.	Lahontan [1]	Earth and gravel fill with concrete spillways.	124	1,400	770,000
New Mexico:					
Carlsbad	Avalon [1]	Earth and rock fill, concrete core.	50	1,380	168,773
Do.	McMillan [1]	Earth and rock fill	55	2,070	150,744
Hondo	Hondo [1]	6-earth embankments	25	17,371	639,993
New Mexico-Texas: Rio Grande.	Elephant Butte [1]	Rubble concrete, gravity, straight structure.	318	[2] 1,674	[3] 605,200
Do.	Elephant Butte Dike [1]	Earth fill	42	1,900	164,650
Oklahoma: Lawton	Medicine Bluff [4]	Rubble masonry	55	357	9,500
Oregon: Umatilla	Cold Springs [1]	Earth fill	98	3,800	789,500
Oregon - California: Klamath.	Clear Lake [1]	Rock fill	33	790	56,600
South Dakota: Belle Fourche.	Belle Fourche [1]	Earth fill	115	6,200	1,600,000
Do.	Nine Mile	....do	28	1,400	50,800
Utah: Strawberry Valley.	Indian Creek Dike [1]	Earth fill, reinforced concrete	37	1,311	101,107
Do.	Strawberry Dam [1]	Earth fill, reinforced concrete corewall.	72	488	108,415
Washington:					
Okanogan	Salmon Lake [1]	Concrete headworks			
Do.	Conconully [1]	Hydraulic earth fill	64	1,000	336,000
Yakima	Bumping Lake [1]	Earth fill	45	3,425	247,700
Do.	Lake Clealum	Earth and gravel fill	125	700	462,000
Do.	Lake Kachess [5]	....do	63	1,400	193,300
Do.	Tieton	Earth and rock fill	194	1,000	1,040,000
Do.	Lake Keechelus [6]	Earth and gravel fill	70	6,500	630,000
Do.	Clear Creek [1]	Single concrete arch	63	210	2,516
Wyoming: Shoshone.	Shoshone [1]	Rubble concrete arch	328	200	78,576
Do.	Ralston [1]	Earth fill	50	150	24,740
INDIAN PROJECTS (see note, page 651).					
Montana:					
Blackfeet	Two Medicine [1]	Earth embankment	36	900	28,600
Do.	Spring Lake	....do	50	1,500	75,000
Do.	Four Horns [7]	....do	62	2,225	149,000
Flathead	Big Draw	Earth	35	3,600	137,000
Do.	Dog Lake	Loose rock and earth	35	2,250	67,000
Do.	Dry Fork	Earth	33	1,860	130,000
Do.	Newell	Concrete	170	850	100,000
Do.	Horte [1]	Earth fill	16	930	3,800
Do.	Hubbart	Loose rock and earth	118	450	302,000
Do.	Kickinghorse	Earth	31	3,700	181,000
Do.	Little Bitter Root	....do	10	300	4,000
Do.	Lower Crow Creek	....do	92	800	330,000
Do.	McConnell	....do	45	1,130	71,000
Do.	McDonald Lake	Loose rock and earth	57	1,500	214,000
Do.	Mission	....do	80	2,500	346,000
Do.	Ninepipe [8]	Earth	38	2,180	162,000
Do.	Pablo [9]	....do	46	14,000	1,028,000
Do.	Polson	....do	85	1,100	170,000
Do.	St. Marys Lake	Loose rock and earth	58	2,200	140,000
Do.	Twin	Earth	30	1,600	46,000
Fort Peck	Little Porcupine [1]	Earth fill	17	4,200	43,400
Do.	Big Porcupine	....do	30	1,500	118,000
Do.	Poplar River	....do	51	5,200	960,000
Do.	Wolf Creek	....do	36		85,300
Do.	Smoke Creek	....do	48		76,000
Total					21,832,695

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[1] Completed.
[2] Including spillway.
[3] Including spillway, 611,000 cubic yards.
[4] Built by city of Lawton, Okla. May be raised 20 feet by Reclamation Service.
[5] Lake Kachess Dam 98 per cent completed June 30, 1916.
[6] Lake Keechelus Dam 86.3 per cent completed June 30, 1916.
[7] First development, 16,000; completed for 4,000 acre-feet.
[8] First development, 64,191; completed for 5,000 acre-feet.
[9] First development, 153,750; completed for 5,000 acre-feet when paved; now paved for 3,000 acre-feet.

Engineering data for projects when completed—Continued.

DIVERSION DAMS.

Projects.	Name.	Type.	Maximum height.	Length, weir.	Volume.
			Feet.	*Feet.*	*Cubic yds.*
Arizona: Salt River	Granite Reef[1]	Rubble concrete weir	38	1,000	40,000
Do	Power Canal[1]	do	12¾	400	4,800
Do	Joint Head[1]	Concrete weir	10	600	1,740
Arizona-California: Yuma	Laguna[1]	Indian weir, concrete and rock fill.[2]	40	4,780	441,732
California: Orland	South Canal[1]	Concrete on piling, with rock fill.	20	900	2,886
Do	North Side[1]	Concrete weir, with removable timber crest.	8	360	270
Do	East Park Feed Canal.[1]	Concrete arch	44	154	1,777
Colorado:					
Grand Valley	Diversion[1]	Masonry ogee weir with roller crest 10 to 15 feet high.	24	546	25,682
Uncompahgre Valley	Gunnison[1]	Crib on rock fill and movable flashboards.	15¾	237	3,200
Do	Montrose and Delta[1]	Movable flashboard weir	6.8	68½	....
Do	Loutsenhizer[1]	Pile and timber weir	....	100	....
Do	Selig[1]	Movable flashboard weir	6	95½	....
Do	Ironstone[1]	Pile foundation with deck and needle flashboards.	8½	58½	....
Do	East Canal[1]	Movable flashboard weir	(3)	144	....
Do	Garnet[1]	Rock basket and brush dam.	....	....	....
Idaho:					
Boise	Boise River[1]	Rubble concrete weir	45	[4] 246	21,750
Minidoka	Minidoka[1]	Combined diversion and storage dam. (See Storage.)	....	....	....
Montana:					
Milk River	Swift Current[1]	Earth and timber crib	13	2,800	86,700
Do	St. Mary[1]	Concrete	6.5	198	480
Do	Chinook	Reinforced concrete	20	250	3.400
Do	Dodson[5]	Timber crib, rock filled	25	319	12,000
Do	Vandalia[5]	Reinforced concrete	34	1.500	11,000
Sun River	Sun River[1]	Concrete masonry	132	212	6,200
Do	Deep Creek	Reinforced concrete	12	100	500
Montana-North Dakota:					
Lower Yellowstone	Lower Yellowstone[1]	Rock-filled, timber weir	12	700	14,500
Nebraska-Wyoming: North Platte.	Whalen[1]	Concrete weir	29	300	80,740
Nevada: Truckee-Carson.	Truckee River[1]	16 concrete sluiceways	22	171	3,322
Do	Carson River[1]	23 concrete sluiceways	21	240	2,707
New Mexico:					
Carlsbad	Avalon[1]	Combined storage and diversion. (See Storage.)	....	....	....
Hondo	Hondo River[1]	Earth fill	20	100	3,700
New Mexico-Texas: Rio Grande.	Leasburg[1]	Rubble concrete weir	9	600	2,318
Do	Mesilla[1]	do.[6]	16.7	303	2,876
Do	Mexican[7]	Rubble masonry	4.7	320	....
Do	Palomas	Not designed	....	....	....
Do	Percha	do	....	....	....
Oklahoma: Lawton	Medicine Bluff	Concrete weir	15	350	400
Oregon: Umatilla	Feed Canal (Echo)[1].	Concrete weir arch	2½	400	296
Do	Three-Mile Falls[1]	Concrete multiple arch	24	800	4,160
Oregon-California: Klamath.	Lost River[1]	Hollow reinforced concrete	40	290	5,550
South Dakota: Belle Fourche.	Diversion[1]	Concrete weir	23	400	12,149
Utah: Strawberry Valley	Spanish Fork[1]	do	16	70	1,262
Do	Indian Creek Crossing.[1]	Earth	17	1,300	15,183
Do	Horse Creek Crossing[1]	do	6	500	7,376
Do	Diverting dam at Strawberry Dam.[1]	do	6	100	1,146
Do	Diverting dam at rating flume.[1]	do	12	150	1,222
Washington:					
Okanogan	Salmon Creek[1]	Concrete weir	4½	50	132
Yakima	Sunnyside[1]	Concrete ogee weir	8½	500	2,291
Do	Tieton[1]	Concrete and rock-filled crib.	3	110	334
Wyoming: Shoshone	Corbett[1]	Reinforced-concrete weir	18	400	4,951

[1] Completed.
[2] Area formed by Laguna diversion dam, 6,400 acres.
[3] Two weirs, one 6 feet by 72 feet, the other 6 feet 10 inches by 72 feet.
[4] Length, including logway.
[5] Completed, except for installation of movable crest.
[6] With 6 foot 3 inch and 4 foot 6 inch tainter gates.
[7] Constructed by Mexican authorities and used jointly.

Engineering data for projects when completed—Continued.

DIVERSION DAMS—Continued.

Projects.	Name.	Type.	Maximum height.	Length, weir.	Volume.
INDIAN PROJECTS (see note page 651).					
Montana:			*Feet.*	*Feet.*	*Cubic yds.*
Blackfeet	Two Medicine [1]	Brush and rock	4	165	175
Do	Blacktail [1]	Concrete	14	54	290
Do	Badger Birch and Cut Bank.	Not yet designed			
Flathead	Jocko River	Log crib, rock filled [2]			
Do	Little Bitter Root	do			
Do	Mud Creek [1]	Concrete	12	18	116
Do	Crow Creek [1]	do	13	82	330
Do	Post Creek—Kickinghorse.[1]	Log crib, rock filled	7	110	1,500
Do	Post Creek—Pablo Feeder.	do.[2]			
Do	Mission Creek [1]	Log apron	3	80	
Do	Dry Creek	Log crib, rock filled [2]			
Do	Finley Creek	do			
Do	Agency Creek	do			
Do	Big Knife Creek [1]	Concrete	5	6	25
Do	Valley Creek	Log cribbed, rock filled [2]			
Do	Other small creeks	do			
Fort Peck	Little Porcupine [1]	Concrete weir on timber crib	4	150	250
Do	Poplar River [1]	do	4	300	180
Do	Big Porcupine [1]	do	6	150	185
Total					833,783

CANALS.

Projects.	Principal canals.			Mileage, with capacity in second-feet.				
	Name.	Maximum capacity.	Length.	Over 800.	300-800.	50-300.	Less than 50.	Total.
		Sec.-ft.	*Miles.*					
Arizona: Salt River	Power [1]	225	19	32	71	78	566	747
Do	Arizona [1]	2,000	22					
Do	South [1]	1,200	2					
Do	Consolidated [1]	1,000	7½					
Arizona-Cal.: Yuma	Main [1]	1,700	12	17	17	110	260	404
Do	West Main	520	28					
Do	East Main	880	24½					
California: Orland	East Park Feed [1]	250	7			7		7
Do	North Main [1]	80	4.5			8	32	40
Do	South Main [1]	225	9.1			23	75	98
Colorado:								
Grand Valley	Main [1]	1,425	62	5	39	21	232	297
Uncompahgre	South [1]	1,300	12	12		1	50	63
Do	West [1]	120	22			14	27	41
Do	Montrose and Delta [1]	450	32		16	37	80	133
Do	Loutsenhizer [1]	125	15			8	22	30
Do	Selig [1]	300	20		4	17	70	91
Do	Ironstone [3]	350	12		5	13	50	68
Do	East [1]	325	11		4	10	50	64
Do	Garnet [1]	50	10			8	4	12
Idaho:								
Boise	Main South [1]	2,500	34	40	57	165	788	1,050
Do	Mora [1]	915	56					
Do	Deer Flat, Low Line [1]	780	37					
Minidoka	North Side [1]	1,500	8	25	30	95	479	629
Do	South Side [1]	1,000	13					
Kansas: Garden City	Main [1]	115	4			2	2	4
Montana:								
Huntley	Main [1]	500	32		10	19	198	227
Do	Pumping High Line.	60	12					
Milk River	St. Mary [1]	850	29	29				29
Do	Dodson South [3]	900	44	44		66	130	240
Do	Dodson North [1]	200	29			23	37	60

[1] Completed. [2] Not yet designed. [3] Under construction.

Engineering data for projects when completed—Continued.

CANALS—Continued.

Projects.	Principal canals.			Mileage, with capacity in second-feet.				
	Name.	Maximum capacity.	Length.	Over 800.	300-800.	50-300.	Less than 50.	Total.
Montana—Continued.		*Sec.-ft.*	*Miles.*					
Milk River	Vandalia South [1]	300	48			44	41	85
Do	Nelson Reservoir North.[1]	250	45			40	30	70
Do	Nelson Reservoir South.[1]	260	27			26	59	85
Do	Chinook	350	80		30	50	90	170
Sun River	Fort Shaw [2]	175	12			18	103	121
Do	Pishkun Reservoir supply.[1]	2,500	12	12				12
Do	Sun River Slope [1]	1,000	34	34	10	74	286	404
Do	Other units				8	54	210	272
Montana-North Dakota: Lower Yellowstone.	Main [2]	830	66		49	19	190	258
Nebraska-Wyoming North Platte.	Interstate [2]	1,400	95	90	20	92	647	849
Do	Ft. Laramie	1,430	127	62	42	44	[3] 600	748
Nevada: Truckee-Carson	Truckee [2]	1,500	31	42	62	80	511	695
Do	"V" Line [2]	1,500	8					
Do	"L" Line [2]	1,210	14.5					
Do	"S" Line [2]	1,210	18.7					
Do	"D" Line [2]	440	7					
Do	"AA" Line [2]	400	13.4					
Do	"T" Line [2]	400	9					
New Mexico:								
Carlsbad	Main [2]	450	[4] 3		13	12	120	145
Hondo	Main Inlet [2]	[5] 2,900	1.6		3	2	45	50
New Mexico-Texas:								
Rio Grande	Leasburg [2]	485	10.8		47.4	78.5	[8] 27	152.9
Do	Franklin [6]	450	31.4					
Do	West Side [2]	493	14.4					
Do	East Side [2]	240	10.3					
Do	Picacho Branch [7]	90	3.7					
Do	Chamberino Feed [2]	70	2.2					
Do	San Elizario Feeder [2]	220	3.2					
Do	Palomas	100	12					
Do	Arrey	350	30					
North Dakota: North Dakota Pumping.	Bufurd Trenton [2]	60	6			6	39	45
Do	Williston [2]	90	8			3	57	60
Oklahoma: Lawton	Main	60	8			10		10
Oregon: Umatilla	Feed [2]	300	25		33	52	90	175
Do	West extension main	375	26.7					
Do	Maxwell	140	8					
Oregon-California: Klamath.	Main [2]	1,400	9	9	9	42	250	310
Do	Keno [2]	635	1					
Do	Lost River Diversion Channel.	250	8					
Do	East Branch [2]	260	4.5					
Do	South Branch [2]	205	13.2					
Do	Adams [2]	205	12					
Do	Griffith Lateral [2]	190	9					
South Dakota: Belle Fourche.	Inlet [2]	1,600	6½	7	55	105	460	627
Do	North Side. [2]	700	45					
Do	South Side [2]	300	40					
Utah:								
Strawberry Valley	Power [2]	500	3.3		3.3			3.3
Do	Trail Hollow [2]	125	4			4		4
Do	Indian Creek [2]	750	2		2			2
Do	High Line [2]	300	17.5			17.5		17.5
Do	Lateral 3 [1]	30	2.2				2.2	2.2
Do	Lateral 20 [1]	55	6.1			1.1	5	6.1

[1] Under construction.
[2] Completed.
[3] Estimated.
[4] Main and Southern canals, 31 miles.
[5] Sidehill canal, built to be utilized as wasteway; length, 8,275 feet.
[6] Old canal purchased by U. S. Reclamation Service and partly reconstructed.
[7] 2.3 miles constructed.
[8] Estimated lateral system not yet planned, so mileage can not be accurately determined.

Engineering data for projects when completed—Continued.

CANALS—Continued.

Projects.	Principal canals.			Mileage, with capacity in second-feet.				
	Name.	Maximum capacity.	Length.	Over 800.	300-800.	50-300.	Less than 50.	Total.
Utah—Continued.		*Sec.-ft.*	*Miles.*					
Strawberry Valley	Lateral 30[1]	66	8.5			3.5	5	8.5
Do	Lateral 31[2]	10						
Do	Lateral 32[1]	50	2.9			0.8	2.1	2.9
Do	Lateral 33	150	2.2			2.2		2.2
Do	Lateral 34[2]	55	11.1			1.3	9.8	11.1
Do	Miscellaneous laterals and sublaterals.	12	31.4				31.4	[3]31.4
Washington:								
Okanogan	Main[4]	110	2			10	66	76
Yakima	Sunnyside Main[4]	1,200	60	31	19	15	342	407
Do	Snipes Mountain	160	13			10	42	52
Do	Rocky Ford	100	13			1	29	30
Do	Mabton	110	14			8	44	52
Do	Benton Extension	80	16			9	13	22
Do	Tieton[4]	300	12		12	32	291	335
Wyoming: Shoshone	Garland[4]	1,000	18	11	44	100	710	865
INDIAN PROJECTS (see note, page 651.).								
Montana:								
Blackfeet	Two Medicine	350	25		55	144	600	799
Do	Fisher	370	30					
Do	Birch	45	6					
Do	Cutbank North	250	30					
Do	Cutbank South	300	20					
Do	Four Horns Supply	165	12					
Flathead	St. Marys Feeder	300	11		14	82	800	896
Do	Pablo Feeder	300	44					
Do	Kickinghorse Feeder[4]	400	4					
Do	Ninepipe Feeder	250	2					
Do	Pablo Lateral A[4]	400	17					
Do	Camas A	300	20					
Fort Peck	Little Porcupine[4]	250	1			1	13	14
Do	Poplar River B[4]	100	29			11	22	33
Do	Poplar River C[4]	100				18	48	66
Do	Big Porcupine[4]	100	7			7	25	32
Do	Missouri Gravity	625	100		10	30	60	100
Total				502	793.7	2,084.9	10,167.5	13,548.1

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[1] Under construction.
[2] To be built in fiscal year 1917.
[3] Includes 10 miles of sublaterals to be built in fiscal year 1917.
[4] Completed.

TUNNELS.

Projects.	Name.	Length.	Capacity.
Arizona: Salt River. (All Salt River tunnels built.)	Power Canal:[1]	*Feet.*	*Second-feet.*
	Intake	1,695	
	Lee	122	
	Wehri cut-off—		
	No. 1	428	
	No. 2	129	
	No. 3	271	
	Wehri	151	
	Pinto	999	
	Chilton	1,027	
	Robinson	152	
	Grav	761	
	Moffet	214	
	Grapevine	872	
	No. 6	206	
	No. 7	342	
	No. 8	553	
	No. 9	320	

[1] Completed.

Engineering data for project when completed—Continued.

TUNNELS—Continued.

Projects.	Name.	Length.	Capacity.
Arizona: Salt River. (All Salt River tunnels built.)—Continued.	Power Canal—Continued.	*Feet.*	*Second-feet.*
	No. 10	489	....
	No. 11	625	....
	No. 12	70	....
	No. 13	110	....
	Roosevelt:[1]		
	Sluicing	480	....
	Outlet	167	....
	Penstock	620	....
Arizona-California: Yuma	Colorado River siphon[1]	930	1,400
Colorado:			
Grand Valley	Main Canal:		
	No. 1[1]	3,723	1,425
	No. 2[1]	1,655	1,425
	No. 3[1]	7,292	670
Uncompahgre	Gunnison[1]	30,645	1,300
	South Canal:[1]		
	No. 1	482	1,300
	No. 2	395	1,300
	No. 3	1,000	1,300
	No. 4	400	1,300
	No. 5	390	1,300
	West Canal[1]	1,750	100
	West Canal Extension[1]	800	30
	Lower Selig Extension:[1]		
	No. 1	160	140
	No. 2	360	140
	No. 3	100	100
	No. 4	310	100
Idaho: Boise	Penitentiary	322	10
	Arrowrock Logway[2]	159	....
Montana:			
Huntley	Main Canal:		
	No. 1[1]	724	400
	No. 2[1]	1,545	400
	No. 3[1]	385	400
Sun River	Willow Creek[1]	584	725
	Sun River Storage	200	3,500
	Pishkum Canal:		
	No. 1[1]	695	2,800
	No. 2[1]	1,022	2,500
	No. 3[1]	2,277	2,500
	Sun River Diversion Tunnel[1]	87	400
	Muddy Creek Reservoir	700	284
Nebraska-Wyoming: North Platte	Pathfinder:[1]		
	North[1]	480	6,000
	South[1]	360	6,400
	Drainage[1]	155	(3)
	Auxiliary[1]	209	(3)
	Crosscut[1]	55	(3)
	Fort Laramie:		
	No. 1	2,700	1,430
	No. 2	2,150	1,430
	No. 3	3,700	360
Nevada: Truckee-Carson	Truckee Canal:[1].		
	No. 1[1]	901	....
	No. 2[1]	309	....
	No. 3[1]	1,515	....
	Gilpin Spillway[1]	115	....
New Mexico: Carlsbad	Spillway:		
	No. 1[1]	97	8,000
	No. 2[1]	103	8,000
Oregon: Umatilla	Spillway from Feed Canal[1]	34	450
Oregon-California: Klamath	Main Canal[1]	3,300	1,200
South Dakota: Belle Fourche	South Canal[1]	1,306	350
Utah: Strawberry Valley	Strawberry[1]	19,897	600
	Strawberry Dam Sluicing[1]	532	600
	Power Canal:		
	No. 1[1]	800	500
	No. 2[1]	705	500
	Highline No. 1[1]	227	300
Washington:			
Okanogan	Conconully outlet[1]	395	900
Yakima, Tieton	Steeple, No. 1[1]	55	350

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[1] Completed.

[2] Not intended to carry water, but for the purpose of running logs which are carried over the dam and brought down through a cableway chute which ends in this tunnel.

[3] Not designed for discharge.

Engineering data for project when completed—Continued.

TUNNELS—Continued.

Projects.	Name.	Length.	Capacity.
		Feet.	*Second-feet.*
Washington—Continued.	Steeple, No. 2[1]	48	350
	Trail Creek[1]	3,120	300
	Columnar[1]	1,200	300
	Tieton[1]	2,729	300
	North Fork[1]	3,811	300
Wyoming: Shoshone[2]	Dam:[1]		
	Lower outlet	498	
	Spillway	405	
	Upper outlet	315	
	Corbett[1]	17,355	
	Ralston Reservoir[1]	245	
	Shoshone Road:[1]		
	No. 1	39	
	No. 2	45	
	No. 3	14	
	No. 4	28	
	No. 5	136	
	No. 6	166	
	Highline Canal:		
	No. 1	4,497	
	No. 2	247	
	No. 3	2,100	
	No. 4	835	
	No. 5	265	
	No. 6	2,025	
	No. 7	290	
	No. 8	283	
	No. 9	120	
	No. 10	185	
	Willwood:		
	No. 1	560	
	No. 2	375	
INDIAN PROJECTS (see note, p. 651.)			
Montana: Flathead	Newell[3]	1,800	2,500
	St. Marys Lake Outlet	1,620	400
	Pablo 31A[1]	441	200
Fort Peck	Missouri River	4,300	625
Total		160,092	

[1] Completed.

[2] Ralston Reservoir tunnel is a sluicing tunnel for the settling basin of Corbett Tunnel.

[3] 1,703 feet driven. Completed for first development (unlined).

IRRIGABLE AREA.

State, project, and unit.	Public land.			State land.	Indian land.	Private land.		Total.
	Entered.	Open.	Withdrawn.			Railroad.	Other.	
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Arizona: Salt River	**16,170**			11,030			**164,448**	**191,648**
Gravity system								182,648
Pumping system								9,000
Arizona-California: Yuma	**6,500**		**44,000**	7,100	**8,500**		**61,900**	**128,000**
Arizona			44,000	7,100			61,900	113,000
California	6,500				8,500			15,000
Units—								
Gila Valley (Ariz.)			5,500	1,300			11,200	18,000
Yuma Valley (Ariz.)			6,900	3,100			45,000	55,000
Mesa pumping (Ariz.)			31,600	2,700			5,700	40,000
Reservation (Cal.)	6,500				8,500			15,000
California: Orland							**20,193**	**20,193**
North side							6,772	6,772
South side							13,421	13,421
Colorado: Grand Valley	**9,880**		**20,190**				**22,930**	**53,000**
Gravity system	7,350		16,060				19,340	42,750
Pumping system	2,530		4,130				3,590	10,250
Colorado: Uncompahgre Valley	**25,578**		**12,674**				**101,748**	**140,000**
South Canal system	4,000		1,100				8,500	13,600
West Canal system	2,500		200				4,500	7,200
Montrose and Delta Canal system	5,000		1,200				27,400	**33,600**

Engineering data for projects when completed—Continued.

IRRIGABLE AREA—Continued.

State, project, and unit.	Public land.			State land.	Indian land.	Private land.		Total.
	En-tered.	Open.	With-drawn.			Rail-road.	Other.	
Colorado—Continued.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Lontsenhizer Canal system	200		100				10,900	11,200
Selig Canal system	6,000		6,000				10,400	22,400
Ironstone Canal system	1,226		1,574				23,200	26,000
East Canal system	6,600		2,500				12,900	22,000
Garnet Canal system	52						3,948	4,000
Idaho: Boise	**73,785**	**420**		**8,700**			**172,095**	**255,000**
Present project lands	70,085	120		5,200			74,595	150,000
Vested water-right lands, including Pioneer, Nampa-Meridian, and New York districts							80,000	80,000
Proposed extensions, including pumping areas	3,700	300		3,500			17,500	25,000
Idaho: Minidoka	**93,823**	**1,806**	**858**	**22,147**			**1,666**	**120,300**
Gravity system	63,686	1,806	858	5,273			217	71,840
Pumping system	30,137			16,874			1,449	48,460
Kansas: Garden City							**10,677**	**10,677**
Montana: Huntley	**25,800**	**3,107**					**3,998**	**32,905**
First	23,968	1,881					3,124	28,973
Second	860	119					874	1,853
Third	972	1,107						2,079
Montana: Milk River	**46,000**		**25,900**	**9,300**	**30,000**		**108,800**	**220,000**
Dodson north	3,339		560	481			7,588	11,968
Dodson south	9,367		16,612	2,608			13,905	42,492
Nelson Reservoir north	6,400		2,940	230			14,430	24,000
Nelson Reservoir south	12,614		2,408	1,446			5,532	22,000
Vandalia south	6,780		1,080	1,835			12,845	22,540
Chinook	7,500		2,300	2,700	30,000		54,500	97,000
Montana: Sun River	**46,434**	**2,312**	**36,078**	**12,546**			**76,652**	**174,022**
Fort Shaw	10,506	2,312	570	268			2,666	16,322
Great Falls				1,400			14,300	15,700
Spring Valley	480		10,000	1,440			3,080	15,000
Greenfields	29,988		21,228	6,058			17,726	75,000
Greenfields Lake	5,460		4,280	1,120			4,140	15,000
Benton Lake				1,520			19,480	21,000
Muddy Creek Canal				740			15,260	16,000
Montana-North Dakota: Lower Yellowstone	**15,992**	**167**	**1,698**	**1,653**		**3,839**	**36,767**	**60,116**
First unit	8,968	167	385	1,068		2,856	28,856	42,300
Extensions	7,024		1,313	585		983	7,911	17,816
Nebraska-Wyoming: North Platte	**107,005**	**1,288**	**35,083**	**12,514**			**74,001**	**229,891**
Interstate unit	81,310	1,288	610	5,338			41,345	129,891
Nebraska	79,013	966	610	5,338			23,295	109,222
Wyoming	2,297	322					18,050	20,669
Units—								
North Platte Canal & Colonization Co							17,837	17,837
First lateral district	32,265	789	337	2,128			4,124	39,643
Second lateral district	20,556	176	126	1,012			11,753	33,623
Third lateral district	28,489	323	147	2,198			7,631	38,788
Fort Laramie unit	25,695		34,473	7,176			32,656	100,000
Nebraska	8,542		7,191	3,315			26,179	45,227
Wyoming	17,153		27,282	3,861			6,477	54,773
Nevada: Truckee-Carson	**18,401**	**4,340**	**100,779**	**215**	**4,640**	**26,900**	**50,725**	**206,000**
Lahontan Valley (Lower Carson)								151,000
Truckee Canal district								13,800
Lahontan Bench								7,200
Churchill Valley								14,000
Pyramid Lake extension								20,000
New Mexico: Carlsbad	**166**			**923**			**23,707**	**24,796**
First	10						20,263	20,273
Second	156			923			3,444	4,523
New Mexico: Hondo	**240**						**9,760**	**10,000**
New Mexico-Texas: Rio Grande	**300**		**5,143**	**2,602**		**360**	**146,595**	**155,000**
New Mexico	300		5,143	2,602			101,955	110,000
Texas						360	44,640	45,000
Units—								
Palomas Valley			574	119			6,292	6,985
Rincon Valley			256	1,867			19,658	21,781

Engineering data for projects when completed—Continued.

IRRIGABLE AREA—Continued.

State, project, and unit.	Public land.			State land.	Indian land.	Private land.		Total.
	Entered.	Open.	Withdrawn.			Railroad.	Other.	
New Mexico—Texas—Contd.								
Units—Continued.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Mesilla Valley, Leasburg unit			1,014	279			35,479	**36,772**
Mesilla Valley, other units	300		3,299	337			56,496	**60,432**
El Paso Valley						360	28,670	**29,030**
North Dakota: North Dakota pumping	**303**	**532**	**78**	**1,073**			**24,287**	**26,273**
Buford-Trenton	249	212	78	1,006			13,480	15,025
First division	249	212	78	91			3,420	4,050
Extensions				14			1,361	1,375
Upper bottom division				501			2,099	2,600
Lower bottom division							4,000	4,000
Trenton Flat				400			2,600	3,000
Williston	54	320		67			10,807	11,248
First division	54	320		67			7,707	8,148
West bottom division							1,900	1,900
East bottom division							1,200	1,200
Oklahoma: Lawton							**2,500**	**2,500**
Oregon: Umatilla	**2.830**	**713**	**4,228**			**2,867**	**25,663**	**36,301**
First	386					320	6,262	6,968
Second	534	61				78	3,677	4,350
Third	1.249					919	1,789	3,957
Fourth	349					90	1,537	1,976
Fifth	155							155
Sixth (west extension)	157	652				399	1,092	2,300
Umatilla			150				1,000	1,150
Future			4,078			1,061	10,306	15.445
Oregon-California: Klamath	**62**	**30,123**					**112,611**	**142,796**
Oregon	62	692					107,500	108,254
California		29,431					5,111	34,542
Units—								
First	62	23					29,615	29,700
Second							8,366	8,366
Third		30,100						30,100
Marginal lands (Tule)							3,400	3,400
Sand Hollow							13,500	13,500
Horsefly							22,000	22,000
Pine Grove							3,730	3,730
Additional units							32,000	32,000
South Dakota: Belle Fourche	**30,696**	**3,781**	**19,326**	**4,503**			**39,610**	**97,916**
First	3,235	363		577			16,735	20,910
Second	8,500	1,545		2,129			16,227	28,401
Third	10,448	282		1,065			5,118	16,913
Fourth	8,513	1,591		732			1,530	12,366
Utah: Strawberry Valley			**3,500**				**46,500**	**50,000**
Mapleton							3,500	3,500
Lake Shore							2,500	2,500
High Line			3,500				20,500	24,000
Spanish Fork							20,000	20,000
Washington: Okanogan							**10,099**	**10,099**
First							2,018	2,018
Second							6,085	6,085
Third							464	464
Old water rights							1,381	1,381
Town of Okanogan							151	151
Washington: Yakima	**4,613**	**2,087**	**93**	**2,808**		**329**	**136,634**	**146,564**
Sunnyside unit	2.604			1,158			107,066	110,828
Vested water-right lands							47,186	47,186
Public-notice lands	1,526			920			40,803	43,249
Irrigation-district lands	1,078			238			19,077	20,393
Tieton unit	2,009	2,087	93	1,650		329	29,568	35,736
Naches Ridge, division 1	304	304	64	947			9,484	11,103
Cowiche-Yakima, division 2	72	99	19	567		53	7,203	8,013
Wide Hollow, division 3	1,633	1,684	10	136		276	12,881	16,620
Wyoming: Shoshone	**36,745**	**3,847**	**98,210**	**6,326**			**2,237**	**147,365**
First								15,193
Second								14,926
Third								2,777
Fourth								6,206
Fifth (lateral A extension)								3,563
Subsequent units								104,700

Engineering data for projects when completed—Continued.

IRRIGABLE AREA—Continued.

State, project, and unit.	Public land.			State land.	Indian land.	Private land.		Total.
	Entered.	Open.	Withdrawn.			Railroad.	Other.	
INDIAN PROJECTS (see note).	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Montana: Blackfeet	11,000		50,100		61,400			122,500
Cutbank North	11,000		4,320		4,680			20,000
Cutbank South			13,180		4,820			18,000
Two Medicine			19,200		28,800			48,000
Badger-Fisher			13,000		20,000			33,000
Birch			400		3,100			3,500
Montana: Flathead	47,000	500	7,500	11,000	85,010		990	152,000
Jocko	700		230	740	14,330			16,000
Mission	1,000		250	1,470	19,290		990	23,000
Post	9,500	100	3,220	2,830	14,350			30,000
Crow	700		50	100	13,150			14,000
Pablo	16,200	200	3,200	3,910	16,490			40,000
Polson	200		220	85	5,495			6,000
Big Arm	500		290	630	1,580			3,000
Camas	18,200	200	40	1,235	325			20,000
Montana: Fort Peck	9,713	107		180	141,920		80	152,000
Little Porcupine					2,610			2,610
Poplar River					28,610		80	28,690
Big Porcupine					4,000			4,000
Big Muddy					18,930			18,930
Missouri River					77,770			77,770
Galpin Bottom pumping	9,713	107		180				10,000
Milk River					10,000			10,000
Total, all projects	629,036	55,130	465,438	114,620	331,470	34,295	1,487,873	3,117,862
Per cent	20.1	1.8	14.9	3.7	10.6	1.1	47.8	100.0

SUMMARY OF CONSTRUCTION RESULTS.

Summary of construction results to June 30, 1916.

State and project.	Irrigable lands.										Available (original) reservoir capacity.
	Estimated on completion.		Service could have supplied June 30, 1916.		June 30, 1916.						
					Under water rights.		Under rental contracts, etc.		Total under contract.		
	Acres.	Farms.	Acres.	Farms.	Acres.	Farms.	Acres.	Farms.	Acres.	Farms.	*Acre-feet.*
Arizona: Salt River	191,648	3,700	191,648	3,700	....	....	191,754	3,700	191,754	3,700	1,367,300
Arizona-California: Yuma	128,000	2,797	72,440	1,800	14,540	265	57,900	472	72,440	737	....
California: Orland	20,193	509	20,193	509	....	....	20,193	509	20,193	509	51,600
Colorado:											
Grand Valley	53,000	900	14,500	375	....	....	2,576	72	2,576	72	....
Uncompahgre Valley	140,000	3,500	85,000	1,375	....	....	55,000	1,375	55,000	1,375	....
Idaho:											
Boise	[1] 255,000	4,250	[2] 230,000	3,926	....	....	198,000	3,750	198,000	3,750	427,000
Minidoka	120,300	2,322	120,300	2,322	109,619	1,909	70	3	109,689	1,912	53,500
Idaho-Wyoming:											
Snake River Storage	....	....	....	....	....	....	....	....	....	....	380,000
Jackson Lake enlargement	....	....	....	....	....	....	....	....	....	....	409,000
Kansas: Garden City	10,677	284	....	....	....	....	....	....	....	....	....
Montana:											
Huntley	32,905	691	32,905	691	26,711	599	....	....	26,711	599	....
Milk River	220,000	1,800	45,000	334	....	....	4,460	68	4,460	68	[3] 27,830
Sun River	174,022	2,900	16,322	265	11,129	199	588	4	11,717	203	16,700
Montana-North Dakota: Lower Yellowstone	60,116	723	42,300	502	2,485	41	27,798	356	30,283	397	....
Nebraska-Wyoming:											
North Platte (Interstate)	129,891	1,467	129,891	1,467	86,441	1,111	[4] 34,006	229	120,447	1,340	1,148,400
North Platte, Fort Laramie unit	100,000	1,150	....	....	....	....	....	....	....	....	....
Nevada: Truckee-Carson	206,000	3,455	69,100	832	33,900	502	13,098	109	46,998	611	350,000
New Mexico:											
Carlsbad	24,796	650	24,796	650	22,530	594	95	3	22,625	597	77,000
Hondo	10,000	125	1,650	28	....	....	1,650	28	1,650	28	40,000
New Mexico-Texas: Rio Grande	155,000	5,000	85,000	3,000	....	....	62,000	2,000	62,000	2,000	2,638,860
North Dakota:											
North Dakota pumping, Buford-Trenton unit	15,025	250	4,049	41	1,998	26	....	....	1,998	26	....
North Dakota pumping, Williston unit	11,248	186	[5] 8,189	134	4,762	112	....	....	4,762	112	....

Oklahoma: Lawton	2,500	100	...	...	...	...	...	...	...	...	12,000
Oregon: Umatilla	36,301	1,450	19,000	([6]) 760	14,113	540	950	[6] 36	15,063	576	50,000
Oregon-California: Klamath	142,796	1,956	47,600	638	26,371	442	12,534	142	38,905	584	726,000
South Dakota: Belle Fourche	97,916	1,292	78,591	867	61,313	800	...	...	61,313	800	203,770
Utah: Strawberry Valley	50,000	1,500	50,000	1,500	24,533	910	...	...	24,533	910	278,000
Washington:											
Okanogan	10,099	560	10,099	560	8,123	475	1,531	65	9,654	540	15,600
Yakima, storage unit	...	...	...	...	...	...	...	...	...	...	[7] 268,000
Yakima, Sunnyside unit	110,828	4,440	93,226	4,050	27,932	1,117	58,946	2,560	86,878	3,677	...
Yakima, Tieton unit	35,736	1,480	33,520	1,300	28,890	1,290	...	...	28,890	1,290	2,000
Wyoming: Shoshone	147,365	2,100	42,665	650	37,570	604	150	...	37,720	604	458,700
INDIAN PROJECTS (see note).											
Montana:											
Blackfeet	122,500	3,060	46,640	1,157	...	...	3,000	46	3,000	46	20,000
Flathead	152,000	2,980	63,000	1,090	...	...	16,944	307	16,944	307	10,000
Fort Peck	152,000	2,790	12,620	303	...	...	1,500	48	1,500	48	3,900
Total to June 30, 1916	3,117,862	60,367	1,690,244	34,826	542,960	11,536	764,743	15,882	1,307,703	27,418	9,035,160
Total to June 30, 1915	3,118,011	60,603	1,450,407	29,017	461,632	10,122	626,371	13,008	1,088,003	23,130	6,500,360
Increase	[8] −149	[8] −236	239,837	5,809	81,328	1,414	138,872	2,874	219,700	4,288	2,534,800

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[1] Includes 80,000 acres of vested water-right lands and 25,000 acres of land under proposed extensions.
[2] Includes 80,000 acres of vested water-right lands.
[3] Increase of 25,000 acre-feet, due to completion of Nelson Reservoir, first development.
[4] Includes 17,837 acres of North Platte Canal & Colonization Co. land.
[5] Includes 41 acres deducted for 71 city lots released.
[6] Estimated. About 75 per cent of land will not be subdivided.
[7] Increase in storage capacity, due to placing flashboards on spillway of crib dam at Lake Clealum.
[8] Reduction due to revision of estimates.

NOTE.—The Indian projects are separately classified because they are not constructed under the terms of the reclamation law, but in each case are authorized by specified statute in connection with the appropriation for the Indian Office.

Summary of construction results to June 30, 1916—Continued.

State and project.	Canals and drains (miles).										Tunnels.	
	Canals.					Waste water ditches.	Drains.		Total drains and ditches.	Grand total.	Number.	Length (feet).
	Capacity (second-feet).				Total.		Open.	Closed.				
	Over 800.	301 to 800.	50 to 300.	Less than 50.								
Arizona: Salt River	32	71	78	625	806	14			14	820	23	10,803
Water-users' work		6			6					6		
South Side work			17	49	66					66		
Arizona-California: Yuma	17	12	62	225	316	1	11	4	16	332	1	930
California: Orland			38	107	145		1		1	146		
Colorado:												
Grand Valley	5	39	15	123	182	2	1	1	4	186	3	12,670
Uncompahgre Valley	12	27	103	246	388	10			10	398	12	36,792
Idaho:												
Boise	40	57	165	719	981	67	89	1	157	1,138	3	968
Minidoka	25	30	95	479	629	10	109		119	748		
Idaho-Wyoming:												
Snake River storage												
Jackson Lake enlargement												
Kansas: Garden City			2	2	4					4		
Montana:												
Huntley		10	19	198	227	72	12	38	122	349	3	2,654
Milk River	8	36	109	118	271	91		1	92	363		
Milk River, St. Mary storage	29				29					29		
Sun River	14	42	53	129	238	12			12	250	5	4,665
Montana-North Dakota: Lower Yellowstone		49	19	145	213	36			36	249		
Nebraska-Wyoming:												
North Platte (Interstate)	90	20	92	647	849	20	17	10	47	896	5	1,259
North Platte, Fort Laramie unit	10				10					10		
Nevada: Truckee-Carson	42	62	80	342	526		180	4	184	710	4	2,840
New Mexico:												
Carlsbad		13	12	120	145		9	4	13	158	2	200
Hondo		3	2	45	50					50		
New Mexico-Texas: Rio Grande		39	35	1	75		2		2	77		
North Dakota:												
North Dakota pumping, Buford-Trenton unit			1	14	15					15		
North Dakota pumping, Williston unit			3	43	46	15			15	61		

Oklahoma-Lawton												
Oregon: Umatilla		33	48	66	147	10			10	157	1	34
Oregon-California: Klamath	9	9	56	222	296	10	49		59	355	1	3,300
South Dakota: Belle Fourche	7	43	103	451	604	12			12	616	1	1,306
Utah: Strawberry Valley		5	29	36	70					70	5	22,161
Washington:												
Okanogan			10	66	76		1		1	77	1	395
Yakima, Sunnyside unit	31	19	44	478	572	10			10	582		
Yakima, Tieton unit		12	32	291	335		1		1	336	6	10,963
Wyoming: Shoshone	11	16	41	226	294	29	10	55	94	388	11	19,249
INDIAN PROJECTS (see note, page 663).												
Arizona: Gila River			11	9	20	1			1	21		
Montana:												
Blackfeet			85	261	346					346		
Flathead		11	85	324	420			2	2	422	2	2,144
Fort Peck			86	34	120					120		
Total to June 30, 1916	382	664	1,580	6,891	9,517	422	492	120	1,034	10,551	[2]89	[2]133,333
Total to June 30, 1915	359	610	1,420	6,371	8,760	414	418	91	923	9,683	89	133,300
Increase	23	54	160	520	757	8	74	29	111	868		33

[1] Decrease in open drains due to exclusion of berm ditches formerly carried under this heading.

[2] Arrowrock Tunnel has been closed but is included.

Summary of construction results to June 30, 1916—Continued.

State and project.	Storage dams.				Diversion dams.					Levees and dikes.	
	Masonry.	Earth.	Rock fill.	Total.	Masonry.	Earth.	Rock fill.	Crib.	Total.	Length.	Volume.
	Cu. yds.	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Miles.*	*Cu. yds.*
Arizona: Salt River	342,325			342,325	46,729		740		47,469	1.4	82,104
Arizona-California: Yuma					66,714		375,018		441,732	55.5	2,930,074
California: Orland	12,200			12,200	2,816				2,816	.4	6,900
Colorado:											
Grand Valley					[1] 25,682				25,682	.1	1,178
Uncompahgre Valley					1,500			1,700	3,200	.6	10,825
Idaho:											
Boise	585,165	2,420,380		3,005,545	21,749				21,749	.2	3,761
Minidoka	16,564	146,677	79,321	242,562						.6	3,472
Idaho-Wyoming:											
Snake River storage	3,649	63,345	4,037	71,031							
Jackson Lake enlargement	11,277	291,874	12,561	315,712							
Montana:											
Milk River		15,700		15,700	11,610	14,900	8,350	8,363	43,223	7.3	192,040
Milk River, St. Mary storage		20,458	435	20,893	437	16,565			17,002	2.4	164,302
Sun River		195,416	9,709	205,125	6,184				6,184	.7	4,972
Montana-North Dakota: Lower Yellowstone							14,500		14,500	6.9	138,276
Nebraska-Wyoming: North Platte (Interstate)	61,444	998,220		1,059,664	4,966	75,775			80,741	.3	131,110
Nevada: Truckee-Carson	69,327	346,377	265,550	681,254	6,028	29,803			35,831	10.9	92,176
New Mexico:											
Carlsbad		100,643	50,101	150,744	6,251	107,146	55,376		168,773	1.8	210,972
Hondo		[2] 616.282	[2] 23,710	[2] 639,992			3,700		3,700		
New Mexico-Texas: Rio Grande	[3] 611,000	164,650		775,650	5,194				5,194	1.3	38,343
Oklahoma: Lawton	9,500			9.500							
Oregon: Umatilla	3,900	757,000	32,500	793,400	4,640	7,830	890	500	13,860	.3	8,000
Oregon-California: Klamath		23,100	33,500	56,600	5,600	13,100			18,700	1.1	40,300
South Dakota: Belle Fourche	26,160	1,546,000		1,572,160	12,149	4,800			16,949		
Utah: Strawberry Valley		108,415		108,415	1,262	24,927			26,189	.3	102,517
Washington:											
Okanogan		336,000		336,000	132	630	130		892		
Yakima, storage unit		817,780		817,780							
Yakima, Sunnyside unit					2,291				2,291	.3	18,000
Yakima, Tieton unit	2,516			2,516	609	2,070	301		2,980	.1	584
Wyoming: Shoshone	75,576			75,576	4,951	5,200			10,151	.1	5,200

INDIAN PROJECTS (see note, page 663).											
Montana:											
Blackfeet	2,370	38,941	....	41,311	290	....	....	....	290	....	....
Flathead	....	340,489	8	340,497	....	....	....	2,238	2,238	.2	5,000
Fort Peck	....	34,000	....	34,000	615	....	....	900	1,515	....	....
Total to June 30, 1916	1,832,973	9,381,747	511,432	11,726,152	238,399	302,746	459,005	13,701	1,013,851	92.8	4,190,106
Total to June 30, 1915	1,768,067	8,953,272	505,718	11,227,057	224,435	277,837	459,005	13,751	975,028	90.6	4,076,766
Increase	64,906	428,475	5,714	499,095	13,964	24,909	....	[4]—50	38,823	2.2	113,340

[1] Concrete, 17,998 cubic yards; paving and riprap, 7,684 cubic yards.
[2] These items consist of dikes and levees, 17,371 feet in length.
[3] Elephant Butte Dam, 605,200 cubic yards; spillway, 5,800 cubic yards.
[4] Decrease due to reclassification of material.

Summary of construction results to June 30, 1916—Continued.

State and project.	Canal structures—number.									Bridges—number and length.														
	Over $2,000.		$500 to $2,000.		$100 to $500.		Less than $100.			Steel.			Combination.			Wood.			Concrete.			Total.	
	Concrete.	Wood.	Concrete.	Wood.	Concrete.	Wood.	Concrete.	Wood.	Total.	Over 50 feet.	Under 50 feet.	Length.	Over 50 feet.	Under 50 feet.	Length.	Over 50 feet.	Under 50 feet.	Length.	Over 50 feet.	Under 50 feet.	Length.	Number.	Length.
										No.	*No.*	*Ft.*	*No.*	*No.*	*Ft.*	*No.*	*No.*	*Ft.*	*No.*	*Ft.*	*No.*		*Ft.*
Arizona: Salt River	45		267	9	289	461	35	849	1,955	2	1	186	13	33	1,882	9	270	3,759	4	11	694	343	6,521
Water-users' work	6		3		6				15				2	1	131	1		67	1		66	5	264
South Side work			1		38		1	207	247					12	344		31	203				43	547
Arizona-California: Yuma	27	2	36	16	186	416	280	1,359	2,322				5	16	795	10	70	2,572	6	17	714	124	4,081
California: Orland	8		15	1	70	12	1,751	23	1,880					73	707		6	122		204	1,050	283	1,879
Colorado:																							
Grand Valley	24	4	64	36	97	60	15	1,825	2,125							10	118	2,567				128	2,567
Uncompahgre Valley	[1] 28	34	22	61	33	149	5	2,434	[1] 2,766					4	83	16	251	6,323				271	6,406
Idaho:																							
Boise	81		148	35	2,180	1,991	1.803	7,696	13,934	1		96				44	1,067	19.820				1,112	19,916
Minidoka	[2] 27	2	[3] 74	10	[4] 868	346	[5] 69	6,797	8,193					20	820	75	285	12,478				380	13,298
Idaho-Wyoming: Jackson Lake enlargement																[6] 1		360				1	360
Kansas: Garden City	1							3	4								3	60				3	60
Montana:																							
Huntley	26	[7] 3	31	1	107	89	[8] 159	[8] 2,725	3,141	1	1	104					145	2,104				147	2,208
Milk River	44		69	22	142	106	24	784	1,191	1	1	115				14	112	3,574	1		96	129	3,785
Milk River, St. Mary storage	21			12					33	2		400				14	27	1,504				43	1,904
Sun River	29		34	8	39	44	139	568	861		8	225	1		60	10	78	2,919				97	3,204
Montana-North Dakota. Lower Yellowstone	59	1	111	2	46	71	127	1,402	1,819	15	16	1,474		6	141	7	149	2,454				193	4,069
Nebraska-Wyoming: North Platte (Interstate)	32	24	150	25	1,060	36	1,600	[9] 3,551	6,478	11		726	11		726	7	153	4,125				182	5,577
Nevada: Truckee-Carson	68	3	172	5	260	156		1,231	1,895	6	6	692	9	119	3,816	2		360	1		57	143	4,925
New Mexco:																							
Carlsbad	8		6		35		449		498							1	10	385				11	385
Hondo			10		77		11		98								11	130				11	130
New Mexico-Texas: Rio Grande	34	5	[10] 51	60	[11] 94	35	16	130	425	1		300	6	12	734	11	80	3,785	2	12	615	124	5,434

North Dakota:																							
North Dakota pumping, Buford-Trenton unit	2	......	1	......	8	......	......	[12] 80	[12] 91	....	....	....	....	4	68	......	......	....	....	......	......	4	68
North Dakota pumping, Williston unit	8	......	11	......	22	......	3	[13] 445	[13] 489	....	....	....	....	12	225	......	3	31	....	......	......	15	256
Oregon: Umatilla	15	......	13	......	37	......	635	256	956	1	....	185	....	......	....	......	55	1,144	....	3	66	59	1,395
Oregon-California: Klamath	10	5	11	22	52	37	6	882	1,025	....	....	....	....	......	....	20	183	5,506	....	......	......	203	5,506
South Dakota: Belle Fourche	28	1	101	19	257	190	26	3,341	3,963	5	....	360	....	......	....	3	335	3,714	....	2	28	345	4,102
Utah: Strawberry Valley	31	1	10	......	100	......	421	....	563	....	....	....	....	26	644	......	32	775	2	21	365	81	1,784
Washington:																							
Okanogan	1	......	2	......	[14] 59	2	[15] 272	1,630	1,966	....	....	....	....	......	....	......	3	100	....	......	......	8	100
Yakima, storage unit	......	......	......	......	......	......	......	....	....	2	....	276	1	......	140	4	......	300	....	......	......	7	716
Yakima, Sunnyside unit	66	22	35	28	263	18	599	5,533	6,564	1	....	500	....	2	90	7	46	1,423	....	2	27	58	2,040
Yakima, Tieton unit	19	16	79	6	327	43	......	43	533	....	....	....	....	......	....	8	165	3,584	....	......	......	173	3,584
Wyoming: Shoshone	31	2	37	3	118	25	991	818	2,025	4	3	416	....	......	....	12	141	2,857	....	10	96	170	3,369
INDIAN PROJECTS (see note, page 663).																							
Arizona: Gila River	5	......	5	......	40	......	......	....	50	....	9	270	....	......	....	......	......	....	....	1	25	10	295
Montana:																							
Blackfeet	9	2	7	7	42	8	103	1,076	1,254	....	....	....	....	......	....	1	43	997	....	......	......	44	997
Flathead	32	2	48	7	203	80	295	2,129	2,796	....	....	....	....	......	....	3	193	3,787	....	......	......	196	3,787
Fort Peck	13	......	9	......	42	8	145	191	408	....	....	....	....	1	33	......	42	847	....	......	......	43	880
Total to June 30, 1916	838	129	1,633	395	7,197	4,383	9,980	48,008	72,563	53	45	6,325	48	341	11,439	290	4,107	94,736	17	283	3,899	5,184	116,399
Total to June 30, 1915	730	107	1,482	323	6,696	4,129	7,226	44,154	64,847	46	39	5,433	45	195	7,311	270	3,743	85,922	17	267	3,740	4,622	102,406
Increase	108	22	151	72	501	254	2,754	3,854	7,716	7	6	892	3	146	4,128	20	364	8,814	....	16	159	562	13,993

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[1] Includes 2 steel-pipe siphons costing over $2,000 each.

[2] Includes 1 metal structure.

[3] Includes 13 metal structures.

[4] Includes 13 metal structures.

[5] Includes 28 metal structures.

[6] Temporary.

[7] Wood and steel.

[8] Increase due to installation of measuring devices.

[9] Reduction due to replacement of structures by concrete.

[10] Includes 17 metal structures.

[11] Includes 44 metal structures.

[12] Includes 57 turnouts.

[13] Includes 370 turnouts.

[14] Includes 53 metallic structures.

[15] Includes 215 metallic structures.

Summary of construction results to June 30, 1916—Continued.

State and project.	Culverts.										Pipe.							Grand total.
	Concrete.		Metal.		Terra cotta.		Wood.		Total.		Pressure.	Culvert.	Drain.	Total.				
	Number.	Length.	Number.	Length.	Number.	Length.	Number.	Length.	Number.	Length.				Concrete.	Metal.	Terra cotta.	Wood.	
		Feet.		*Feet.*		*Feet.*		*Feet.*		*Feet.*	*Lin. ft.*	*Lin. ft.*	*Lin. ft.*	*Lin. ft.*	*Lin. ft.*	*Lin. ft.*	*Lin. ft.*	*Lin. ft.*
Arizona: Salt River	58	3,089	38	1,170			123	3,107	219	7,366	2,825	4,424	11,246	14,155	1,515		2,825	18,495
Water-users' work											4,244			4,244				4,244
South Side work	40	1,214							40	1,214	6,060	416	618	416	6,060	618		7,094
Arizona-California: Yuma	139	2,680	6	141	5	260	387	6,382	537	9,463	500	437	21,075	36	141	21,335	500	22,012
California: Orland	123	4,318	2	40	8	154			133	4,512	8,938	4,284	48	13,076	40	154		13,270
Colorado:																		
Grand Valley	6	878	26	3,339	79	6,128	25	400	136	10,745	10,541	10,650	5,920		10,979	14,832	1,300	27,111
Uncompahgre Valley	25	2,901	25	1,336	9	608	106	1,962	165	6,807	21,312	2,334	6,708	1,509	9,644	7,150	12,051	30,354
Idaho:																		
Boise	53	3,031	2	108			505	8,772	560	11,911	75,999	2,071	10,090	52,219	3,606	5,352	26,983	88,160
Minidoka	22	2,196	711	18,530			332	9,443	1,065	30,169	10,363	15,197	450	2,255	4,767		18,988	26,010
Idaho-Wyoming: Jackson Lake enlargement											3,872				3,872			3,872
Montana:																		
Huntley	39	2,055	95	3,214	28	1,440	381	8,471	543	15,180	3,120	6,796	201,831	2,826	3,214	205,707		[1] 211,747
Milk River	20	1,686	20	594	59	4,017	9	160	108	6,457	7,205	11,740	3,297	11,214	1,881	9,147		22,242
Milk River, St. Mary storage	8	1,244					85	1,700	93	2,944	4,870	940		1,140	4,670			5,810
Sun River	97	7,937			1	22	136	2,489	234	10,448	610	1,762	26,730	1,661	610	26,831		29,102
Montana-North Dakota: Lower Yellowstone	40	3,822	1	48	47	3,928	223	4,286	311	12,034		6,385	11,806		164	18,027		18,191
Nebraska-Wyoming:																		
North Platte (Interstate)	48	1,439	127	3,033	92	1,885	50	800	317	7,157	5,019	12,581	67,487	3,496	4,345	73,092	4,154	85,087
North Platte, Fort Laramie unit	3	550							3	550		1,152				1,152		1,152
Nevada: Truckee-Carson					5	258	31	1,442	36	1,700	5,727	258	24,803	2,227	3,500	25,061		30,788
New Mexico:																		
Carlsbad	1	400					5	71	6	471	1,389		21,008	2,891		19,506		22,397
Hondo			1	448					1	448		448			448			448
New Mexico-Texas: Rio Grande			23	2,199			12	250	35	2,449	220	4,687			4,345	562		4,907
North Dakota:																		
North Dakota pumping, Buford-Trenton unit	6	230					23	398	29	628	3,196			2,762	434			3,196
North Dakota pumping, Williston unit	25	1,112					78	2,263	103	3,375	2,609			2,283	326			2,609
Oregon: Umatilla	8	289							8	289	[2] 116,634	230	8,547	106,562		8,349	10,500	[2] 125,411
Oregon-California: Klamath	5	751	106	6,512	43	2,705	8	400	162	10,368		9,357		140	6,512	2,705		9,357

South Dakota: Belle Fourche	32	2,812	20	1,996	101	4,924	12	180	165	9,912	30,563	11,376	5,200	7,362	3,436	26,789	9,552	47,139
Utah: Strawberry Valley	4	290	48	815	226	5,849	25	450	303	7,404	2,903	6,536	3,345	....	1,783	11,001	....	12,784
Washington: Okanogan	12	592	3	80	....	....	....	....	15	672	135,207	....	1,650	....	130,790	1,650	4,417	136,857
Washington:																		
Yakima, storage unit	....	....	....	....	....	....	....	....	....	....	2,436	....	....	2,436	....	....	....	2,436
Yakima, Sunnyside unit	16	1,900	....	....	26	1,022	....	....	42	2,922	241,483	1,022	....	6,930	3,440	74,282	157,853	242,505
Yakima, Tieton unit	62	4,212	....	....	....	....	....	....	62	4,212	279,161	....	....	246,132	....	3,622	29,407	279,161
Wyoming: Shoshone	364	11,011	11	650	42	2,624	160	4,920	577	19,205	6,502	14,287	290,644	14,370	650	296,413	....	311,433
INDIAN PROJECTS (see note, page 663).																		
Arizona: Gila River	15	300	....	....	....	....	....	....	15	300	....	....	....	....	....	....	....	....
Montana:																		
Blackfeet	29	2,182	2	36	....	....	87	5,629	118	7,847	1,030	9,770	....	8,388	1,382	....	1,030	10,800
Flathead	64	3,184	3	148	25	772	163	2,954	255	7,058	3,294	11,044	530	7,663	2,729	3,766	710	14,868
Fort Peck	17	440	....	....	....	....	13	218	30	658	....	2,562	....	2,054	508	....	....	2,562
Total to June 30, 1916	1,381	68,745	1,270	44,437	796	36,596	2,979	67,147	6,426	216,925	997,832	152,746	723,033	520,447	215,791	857,103	280,270	1,873,611
Total to June 30, 1915	1,273	61,112	1,146	40,119	567	29,052	2,728	62,663	5,714	192,946	899,255	149,532	526,173	486,635	193,541	634,108	260,676	1,574,960
Increase	108	7,633	124	4,318	229	7,544	251	4,484	712	23,979	98,577	3,214	196,860	33,812	22,250	222,995	19,594	298,651

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[1] Increase due to drainage construction and replacing timber turnouts with vitrified pipe.
[2] Includes 6,035 feet of concrete pipe drops and turnouts.

Summary of construction results to June 30, 1916—Continued.

State and project.	Flumes.								Canal lining.		Buildings.						Wells.	
	Concrete.		Metal.		Wood.		Total.											
	Number.	Length.	Number.	Length.	Number.	Length.	Number.	Length.	Concrete.	Wood.	Offices.	Residences.	Power plants.	Pumping stations.	Barns, storehouses, etc.	Total.	Number.	Depth.
		Feet.		*Feet.*		*Feet.*		*Feet.*	*Miles.*	*Miles.*								*Feet.*
Arizona: Salt River	9	297	10	679	34	1,559	53	2,535	0.5	......	1	22	4	9	10	46	34	8,511
Water users' work	1	595	......	....	....	....	1	595	....	......	......	3	2	......	......	5	1	165
South Side wotk	......	....	......	....	1	16	1	16	....	......	......	....	......	1	......	1	......	....
Arizona-California: Yuma	1	30	......	....	12	1,159	13	1,189	....	.2	1	9	......	[1] 3	6	19	......	....
California: Orland	......	....	4	733	5	500	9	1,233	27	......	1	1	......	......	4	6	3	200
Colorado:																		
Grand Valley	......	....	12	1,313	48	6,063	60	7,376	.1	......	......	1	......	......	......	1	......	....
Uncompahgre Valley	......	....	133	17,762	88	9,833	221	27,595	6	2	3	18	2	......	16	39	......	....
Idaho:																		
Boise	4	442	92	44,562	273	9,328	369	54,332	9	......	11	44	1	......	55	111	4	760
Minidoka	2	190	13	908	200	13,094	215	14,192	.1	......	3	11	1	9	25	49	15	980
Idaho-Wyoming:																		
Snake River storage	......	....	......	....	....	....	....	....	....	......	......	1	......	......	2	3	......	....
Jackson Lake enlargement	......	....	......	....	....	....	....	....	....	......	1	10	2	......	10	23	1	25
Kansas: Garden City	......	....	......	....	....	....	....	....	....	......	......	1	1	23	1	26	216	8,800
Montana:																		
Huntley	2	168	15	2,640	23	2,381	40	5,189	.1	.1	1	11	......	1	11	24	4	625
Milk River	......	....	19	4,235	10	623	29	4,858	.6	......	4	4	......	......	8	16	3	95
Milk River, St. Mary storage	......	....	1	741	....	....	1	741	....	......	4	49	1	......	43	97	2	62
Sun River	......	....	2	330	5	1,638	7	1,968	2	......	6	40	......	4	37	87	7	323
Montana-North Dakota: Lower Yellowstone	10	841	2	580	37	1,363	49	2,784	....	......	4	16	......	......	8	28	8	214
Nebraska-Wyoming:																		
North Platte (Interstate)	2	466	45	11,450	4	136	51	12,052	....	......	2	7	......	......	6	15	15	1,516
North Platte, Fort Laramie unit	......	....	......	....	....	....	....	....	....	......	1	6	......	......	1	8	3	247
Nevada: Truckee-Carson	......	....	2	300	2	220	4	520	2.5	......	5	15	1	1	[2] 7	29	......	....
New Mexico:																		
Carlsbad	1	497	4	2,028	....	....	5	2,525	12	......	1	5	......	......	10	16	1	127
Hondo	......	....	......	....	....	....	....	....	....	......	......	1	......	......	1	2	1	365
New Mexico-Texas: Rio Grande	......	....	14	502	4	218	18	720	2	......	1	130	1	1	41	174	3	61
North Dakota:																		
North Dakota pumping, Buford-Trenton unit	1	42	1	296	....	....	2	338	....	......	1	3	......	2	2	8	1	30
North Dakota pumping, Williston unit	......	....	4	376	1	133	5	509	....	......	2	6	1	3	5	17	2	100
Oregon: Umatilla	......	....	21	1,000	4	365	25	1,365	69	......	1	5	......	......	9	15	5	348
Oregon-California: Klamath	......	....	6	751	24	12,656	30	13,407	.6	1.4	1	6	......	......	12	19	6	690

South Dakota: Belle Fourche	......	......	14	5,080	20	5,640	34	10,720	.4	.2	3	10	......	......	9	22	2	1,968
Utah: Strawberry Valley	[3] 34	7,876	2	1,210	1	164	37	9,250	45.2	......	1	5	1	......	4	11	......	......
Washington: Okanogan	1	46	4	1,480	3	1,290	8	2,816	30	......	1	5	2	1	5	14	......	......
Washington:																		
Yakima, storage unit	......	......	......	......	......	......	......	......	......	......	......	4	......	......	1	5	......	......
Yakima, Sunnyside unit	......	......	15	7,165	527	206,473	542	213,638	21	......	1	19	4	......	4	28	4	610
Yakima, Tieton unit	......	......	16	9,551	121	67,847	137	77,398	12	......	2	15	......	......	3	20	......	......
Wyoming: Shoshone	1	54	18	1,736	111	2,226	130	4,016	.4	......	3	35	......	1	23	62	8	397
INDIAN PROJECTS (see note, p. 663).																		
Arizona; Gila River	......	......	......	......	......	......	......	......	......	......	......	1	1	8	2	12	10	2,054
Montana:																		
Blackfeet	......	......	3	1,216	3	503	6	1,719	......	......	1	1	......	......	2	4	6	184
Flathead	......	......	4	3,583	55	8,414	59	11,997	.5	......	6	21	......	......	21	48	3	80
Fort Peck	......	......	7	1,041	2	90	9	1,131	......	......	3	7	......	......	8	18	3	75
Total to June 30, 1916	69	11,544	483	123,248	1,618	353,932	2,170	488,724	241.0	3.9	76	548	25	67	412	1,128	371	29,612
Total to June 30, 1915	33	4,189	407	112,533	1,461	335,324	1,901	452,046	140.5	3.0	75	520	19	64	390	1,068	367	29,337
Increase	36	7,355	76	10,715	157	18,608	269	36,678	100.5	0.9	1	28	6	3	22	60	4	275

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[1] The pumping station for the North Gila Valley pumping unit was destroyed by the Gila flood of January, 1916, and was not replaced.

[2] Includes 1 power plant substation.

[3] Includes 10 concrete-covered flumes, 2,635 feet in length.

Summary of construction results to June 30, 1916—Continued.

State and project.	Roads.	Railroad track.	Telephone lines.		Transmission lines.	Power plants completed.	Material excavated.				Riprap placed.	Paving placed.	Concrete.	Cement used.	Cement and sand cement manufactured.
			Mileage.	Telephones.			Class 1, earth.	Class 2, indurated material.	Class 3, rock.	Total.					
	Mi.	*Mi.*			*Mi.*	*H. P.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Sq. yds.*	*Cu. yds.*	*Barrels.*	*Barrels.*
Arizona: Salt River	212		215	72	119	13,400	3,846,289	1,026,262	604,473	5,477,024	7,000	12,344	343,028	423,046	338,452
Water-users' work	5				12	10,700	314,781	14,300	117,180	446,261		15,284	13,842	17,722	
South Side work					3		223.496	18,284	4,468	246,248		1,058	1,702	3,058	
Arizona-California: Yuma	25	37	156	123			11,323,848	373,357	1,540,795	13,238,000	826,888	100,903	97,545	98,878	
California: Orland			[1] 50	[1] 7			575,628	192,123	14,425	782,176	2,671	3,223	34,453	38,947	
Colorado:															
Grand Valley	2		55	8			2,807,687	466,642	184,221	3,458,550	5,834	18,392	54,197	63,610	
Uncompahgre Valley	22	7	34	28	7		2,459,061	725,884	458,464	3,643,409	7,073	1,420	90,983	86,084	
Idaho:															
Boise	44	19	221	139	27	2,550	13,785,863	1,402,797	792,230	15,980,890	16,632	66,975	692,990	523,714	586,450
Minidoka	8		138	120	82	10,000	11,079,527	201,750	417,263	11,698,540		93,486	40,185	45,959	
Idaho-Wyoming:															
Snake River storage	36		70	7				183,000	6,750	189,750	4,037	11,400	3,649	3,182	
Jackson Lake enlargement							64,894		6,381	71,275	12,917		11,277	10,588	
Kansas: Garden City			5	4	5	[2] 700	66,400			66,400			5,388	7,571	
Montana:															
Huntley			23	13		286	[3] 2,142,285	22,190	12,600	2,177,075	1,680	2,177	13,284	19,109	
Milk River	6		2	[1] 9			6,088,800	85,300	19,500	6,193,600	11,760	19,570	26,600	33,470	
Milk River, St. Mary storage	76		108	15			2,478,970	18,447	75,607	2,573,024	1,963	20,707	14,357	20,174	
Sun River	37		156	38	43		3,793,428	243,862	386,720	4,424,010	15,982	7,671	36,331	37,893	
Montana-North Dakota: Lower Yellowstone	12		78	35			6,625,050	183,017	195,013	7,003,080	21,843		23,202	30,554	
Nebraska-Wyoming:															
North Platte (Interstate)			[1] 203	[1] 39			11,804,298	632,636	201,600	12,638,534	50,300	63,392	126,480	152,440	
North Platte, Fort Laramie unit							1,210,000	26,000	14,000	1,250,000		300	360	450	
Nevada: Truckee-Carson	65		129	59	20	2,400	9,353,457	282,899	465,826	10,102,182	46,281	47,635	112,202	124,046	29,305
New Mexico:															
Carlsbad	25						1,057,458	67,048	62,095	1,186,601	84,388	7,981	25,029	31,365	
Hondo			15	4			815,382	3,118	35,946	854,446	27,226	969	3,830	2,850	
New Mexico-Texas: Rio Grande	32	13	74	60	10	2,225	2,290,899	201,530	507,170	[4] 2,999,599	[5] 20,639	[6] 15,269	639,402	388,763	621,550
North Dakota:															
North Dakota pumping, Buford-Trenton unit			28	2	28		69,600	50		69,650			1,654	2,599	
North Dakota pumping, Williston unit			4	5	4	1,550	219,100	16		219,116		990	2,632	3,369	
Oregon: Umatilla	7		28	18			3,063,550	152,877	53,447	3,269,874	34,600	4,320	70,240	88,630	
Oregon-California: Klamath			88	46			2,975,611	617,235	137,290	3,730,136	7,900	5,727	18,598	19,564	

South Dakota: Belle Fourche	....	7	88	29	.....	....	7,349,200	133,750	42,144	7,525,094	1,712	68,495	54,475	70,374	....
Utah: Strawberry Valley	67	....	39	12	50	1,600	1,409,100	159,100	219,260	1,787,460	8,935	18,280	78,813	91,983	....
Washington: Okanogan	2	....	35	21	5	550	695,550	100,500	50,270	846,320	1,090	1,000	11,215	13,975	....
Washington:															
Yakima, storage unit	46	....	63	30	.....	....	1,764,876	34,429	19,302	1,818,607	52,148	14,095	18,977	23,872	....
Yakima, Sunnyside unit	....	....	124	50	.....	1,350	2,989,180	99,942	106,898	3,196,020	11,500	11,880	26,843	29,992	....
Yakima, Tieton unit	39	....	68	48	.....	....	762,288	470,374	258,574	1,491,236	5,423	19,087	27,137	39,770	....
Wyoming: Shoshone	56	....	66	27	.....	....	2,979,004	62,811	325,046	3,366,861	7,265	11,616	123,038	144,610	....
INDIAN PROJECTS (see note, p. 663).															
Arizona: Gila River	10	....	23	7	23	....	302,285	16,261	9,452	327,998	....	2,154	1,687	2,109	....
Montana:															
Blackfeet	7	....	115	11	.....	....	1,812,528	41,806	92,728	1,947,062	1,625	6,234	4,226	4,613	....
Flathead	24	....	107	20	.....	....	2,646,181	120,746	41,531	2,808,458	494	33,573	7,933	11,280	....
Fort Peck	....	....	......	......	.....	....	1,031,500	2,200	....	1,033,700	20	415	2,415	2,785	....
Total to June 30, 1916	865	83	2,629	1,106	438	47,311	124,277,054	8,382,543	7,478,669	140,138,266	1,297,826	708,022	2,860,149	2,712,998	1,575,757
Total to June 30, 1915	784	82	2,554	1,069	429	34,526	115,599,284	7,585,948	6,964,136	130,149,368	1,023,398	615,583	2,674,977	2,501,382	1,515,667
Increase	81	1	75	39	9	12,784	8,677,770	796,595	514,533	9,988,898	274,428	92,439	185,172	211,616	60,090

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[1] Rented.
[2] Steam plants.
[3] Increase due to drainage construction and canal extension.
[4] Includes 12,710 cubic yards of riprap.
[5] Included in material excavated.
[6] Asphalt, 2,423 square yards; rock, 12,846 square yards.

SUMMARY OF EQUIPMENT AND EMPLOYEES.

Summary of equipment and employees, June 30, 1916.

State and project.	Air compressors.	Automobiles.	Boats.	Boilers.	Cableways.	Standard-gauge cars.	Narrow-gauge cars.	Concrete cars.	Dump carts.	Other carts.	Concrete mixers.	Stiff-leg derricks.	Guy derricks.	Dredges.	Diamond drills.	Well drills.	Air and steam drills.	Electric drills.
Arizona: Salt River	2	14	1	6	...	...	13	1	2	12	5	2	3	...	...	...	7	3
Arizona-California: Yuma	2	5	1	20	1	159	19	...	...	3	3	5	1	...	...	...	...	...
California: Orland	...	2	1	...	...	...	4	...	...	...	2	...	...	...	...	...	...	...
Colorado:																		
Grand Valley	1	2	...	2	1	...	58	24	2	...	4	2	1	...	...	...	12	1
Uncompahgre Valley	5	3	1	9	...	...	78	8	...	...	3	...	...	...	1	...	18	...
Idaho:																		
Boise—																		
Distribution unit	...	12	2	...	...	...	34	...	20	...	6	1	...	...	1	...	...	...
Storage unit	3	...	3	3	2	39	65	3	...	...	4	8	1	...	1	...	21	...
Minidoka	1	11	...	1	...	...	...	...	1	...	2	1	1	1	...	...	2	...
Idaho-Wyoming:																		
Snake River storage	...	...	...	9	...	...	...	...	...	...	...	...	1	...	...	...	...	...
Jackson Lake enlargement	...	...	2	10	3	...	15	...	...	...	1	...	...	1	...	1	3	...
Kansas: Garden City	...	...	...	1	...	...	2	...	...	...	...	...	...	...	...	...	...	...
Montana:																		
Huntley	...	2	...	2	...	...	...	...	1	4	3	1	...	...	...	...	...	...
Milk River	...	2	3	2	...	...	6	3	...	13	1	1	1	...	...	...	...	...
Milk River, St. Mary storage	...	1	6	4	...	...	4	...	1	6	2	...	2	...	...	...	...	...
Sun River	1	4	1	7	...	...	21	6	5	9	1	2	...	...	3	...	8	...
Montana-North Dakota:																		
Lower Yellowstone	1	2	2	1	1	...	12				1	3	3	...	...	...	...	...
Nebraska-Wyoming:																		
North Platte (Interstate)	2	3	...	3	1	...	6	...	1	12	...	...	4	...	...	1	7	...
North Platte, Fort Laramie unit	...	3	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...
Nevada: Truckee-Carson	...	4	2	...	1	...	19	...	2	4	2	1	4	...	1	1	8	1
New Mexico: Carlsbad	...	2	1	...	...	...	5	...	...	...	2	...	...	...	...	...	...	...
New Mexico-Texas:																		
Rio Grande	...	5	1	...	...	1	...	...	2	...	4	...	...	...	...	...	...	...
Rio Grande, Elephant Butte storage	2	1	...	...	2	66	5	...	7	...	5	14	7	...	...	2	42	1
North Dakota: North Dakota pumping	...	...	2	...	...	...	24	...	...	5	...	...	...	...	...	...	...	...
Oregon: Umatilla	...	1	1	...	...	...	1	9	6	...	3	...	3	...	...	...	...	...
Oregon-California: Klamath	...	5	7	1	...	...	13	...	7	2	1	...	2	...	...	...	4	...
South Dakota: Belle Fourche	1	2	...	...	...	...	26	22	...	...	1	...	...	...	...	7	...	...
Utah: Strawberry Valley	...	2	...	1	...	...	8	12	2	3	3	2	...	...	...	...	...	...
Washington:																		
Okanogan	...	1	...	...	...	...	...	4	...	...	1	...	...	...	...	...	4	...
Yakima—																		
Storage unit	2	1	8	6	...	...	109	4	4	...	2	2	3	1	1	1	10	...
Sunnyside unit	...	3	2	1	...	...	6	...	...	...	3	...	...	...	...	...	...	...
Tieton unit	1	1	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Wyoming: Shoshone	1	3	2	2	2	...	...	16	...	4	1	...	...	...	...	...	...	...
INDIAN PROJECTS (see note, p. 679).																		
Montana:																		
Blackfeet	...	1	1	...	...	...	...	...	...	2	1	...	...	...	...	...	...	...
Flathead	...	3	2	...	...	...	6	...	5	22	3	...	2	...	...	...	1	...
Fort Peck	...	1	...	...	...	...	...	...	3	2	2	...	...	...	...	...	...	...
Total, June 30, 1916	25	102	56	91	14	265	562	112	71	103	73	45	39	3	8	13	147	6

Summary of equipment and employees, June 30, 1916—Continued.

State and project.	Electric generators.		Electric motors.		Electric-light plants.	Gasoline engines.		Steam engines.		Drag-line excavators.	Other excavators.	Elevating graders.	Road graders.	Horses and mules.	Hydraulic rams.	Locomotives, electric.	Locomotives, steam.
		Kw.		*Kw.*			*Hp.*		*Hp.*								
Arizona: Salt River..	4	385	28	462	....	9	37	2	42	1	....	....	1	51	1	1	....
Arizona-California: Yuma..............	2	27	1	10	1	14	340	23	980	3	....	....	1	41	1	....	6
California: Orland....	....	....	1	2	....	5	34	....	....	....	1	....	....	5	....	....	....
Colorado:																	
Grand Valley.....	7	428	34	1,135	1	5	108	2	400	....	....	....	....	50	....	4	....
Uncompahgre Valley..........	4	350	5	112	2	1	12	10	775	....	....	....	1	6	....	3	....
Idaho:																	
Boise—																	
Distribution unit........	....	....	4	6	....	7	35	1	12	1	4	....	1	37	....	....	2
Storage unit..	4	1,950	42	1,500	1	....	....	1	40	....	....	....	2	3	....	....	6
Minidoka.........	1	10	5	112	1	1	25	2	20	....	....	....	....	22	....	....	....
Idaho-Wyoming:																	
Snake River storage............	1	50	....	....	1	....	....	2	45	....	....	1	1	....	....	....	....
Jackson Lake enlargement......	....	....	....	....	....	1	13	7	280	....	....	....	....	26	....	....	....
Kansas: Garden City.	6	470	16	340	1	5	33	....	....	....	....	....	....	....	....	....	....
Montana:																	
Huntley..........	....	....	....	....	....	4	12	....	....	2	1	....	2	10	....	....	....
Milk River.......	1	15	....	....	....	3	6	5	70	....	....	....	1	30	....	....	....
Milk River, St. Mary storage...	2	20	....	....	2	1	30	9	345	1	....	....	2	204	3	....	....
Sun River........	....	....	11	323	....	4	23	5	159	....	....	....	1	49	....	....	2
Montana-North Dakota: Lower Yellowstone..............	....	....	....	....	....	2	8	5	180	....	....	....	....	31	....	....	....
Nebraska-Wyoming:																	
North Platte (Interstate).......	1	45	2	13	....	5	40	10	207	1	1	....	1	94	1	....	....
North Platte, Fort Laramie unit...	....	....	....	....	....	2	8	....	....	....	....	....	....	33	....	....	....
Nevada: Truckee-Carson...............	3	1,500	8	105	1	5	16	1	30	1	....	....	....	26	2	....	1
New Mexico:																	
Carlsbad.........	....	....	....	....	....	2	30	....	....	1	1	1	....	2	1	....	....
Hondo............	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....
New Mexico-Texas:																	
Rio Grande.......	....	....	2	8	....	2	4	....	....	....	....	....	1	16	....	....	....
Rio Grande, Elephant Butte storage.........	5	1,180	52	2,140	1	....	....	1	10	....	....	....	....	9	....	....	3
North Dakota: North Dakota pumping..........	....	....	1	2	....	....	....	....	....	....	....	....	....	3	....	....	....
Oregon: Umatilla.....	....	....	....	....	....	8	43	3	70	1	....	....	....	17	....	....	....
Oregon-California: Klamath...........	2	2	....	....	....	3	19	2	34	2	1	....	1	21	1	....	....
South Dakota: Belle Fourche............	....	....	1	3	1	3	22	1	30	....	....	....	....	61	....	....	1
Utah: Strawberry Valley.............	....	....	2	60	1	1	32	....	....	....	....	1	1	....	....	3	....
Washington:																	
Okanogan.........	2	374	2	300	....	1	2	....	....	....	....	....	....	6	....	....	....
Yakima—																	
Storage unit..	4	282	19	375	2	3	28	8	176	1	....	....	1	126	1	....	6
Sunnyside unit........	....	....	1	3	....	6	29	1	20	....	....	....	1	2	....	....	....
Tieton unit...	....	....	....	....	....	2	10	4	48	....	....	....	1	8	....	....	....
Wyoming: Shoshone..	1	5	1	5	....	11	59	1	40	1	1	1	3	26	3	....	....
INDIAN PROJECTS (see note, p. 679).																	
Montana:																	
Blackfeet........	....	....	....	....	....	2	19	....	....	....	....	1	....	16	....	....	....
Flathead.........	....	....	....	....	....	4	13	1	40	2	....	1	1	60	1	....	....
Fort Peck.......	....	....	....	....	....	....	....	....	....	....	....	....	1	19	....	....	....
Total, June 30, 1916..........	50	7,093	238	7,016	16	122	1,090	107	4,053	18	10	6	25	1,111	15	11	27

Summary of equipment and employees, June 30, 1916—Continued.

State and project.	Motorcycles.	Pile drivers.	Plows.	Pumps.	Rock crushers.	Rollers.	Fresno scrapers.	Slip scrapers.	Wheel scrapers.	Sleighs and sleds.	Sprinklers.	Steam shovels.	Traction engines.	Dump wagons.	Heavy freight wagons.	Light freight wagons.	Spring wagons and buggies.
Arizona: Salt River	22	....	41	35	1	....	116	137	4	....	....	....	....	....	7	73	15
Arizona-California: Yuma	2	1	34	41	2	....	105	25	13	....	1	2	1	4	13	7	8
California: Orland	....	1	8	7	....	....	10	8	3	....	....	....	....	....	3	3	4
Colorado:																	
Grand Valley	1	1	11	8	2	1	34	44	33	1	....	....	....	....	6	11	8
Uncompahgre Valley	2	3	14	15	1	....	21	100	23	....	....	....	....	2	7	....	4
Idaho:																	
Boise—																	
Distribution unit	4	....	37	....	....	....	74	104	14	....	....	1	....	....	11	10	17
Storage unit	....	1	1	10	2	....	....	1	....	1	....	1	....	....	....	2	2
Minidoka	2	2	7	11	....	....	6	2	10	1	....	....	....	....	2	1	9
Idaho-Wyoming:																	
Snake River storage	....	1	....	....	....	....	11	75	24	....	....	....	....	....	....	....	....
Jackson Lake enlargement	....	3	....	9	....	....	5	....	20	12	....	....	....	20	....	4	2
Kansas: Garden City	....	....	3	31	....	....	....	....	....	....	....	....	....	....	....	....	....
Montana:																	
Huntley	1	....	8	7	....	....	2	60	10	....	....	....	....	....	2	1	3
Milk River	2	3	10	12	....	....	16	12	17	5	....	....	....	....	4	12	2
Milk River, St. Mary storage	1	1	34	5	....	1	34	42	....	8	....	2	1	30	18	6	4
Sun River	1	1	6	17	....	....	9	52	17	7	....	1	1	10	14	8	11
Montana - North Dakota: Lower Yellowstone	1	3	12	6	....	....	13	49	14	7	....	....	....	4	8	4	4
Nebraska-Wyoming:																	
North Platte (Interstate)	1	1	23	25	....	....	27	75	53	....	....	....	....	7	6	31	16
North Platte, Fort Laramie unit	1	....	4	....	....	....	6	8	....	....	....	....	....	....	....	7	7
Nevada: Truckee-Carson	1	1	8	31	....	....	35	12	8	....	....	1	1	9	9	14	6
New Mexico:																	
Carlsbad	....	....	5	5	....	1	6	35	25	....	1	....	....	15	2	....	....
Hondo	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	1	1
New Mexico-Texas:																	
Rio Grande	1	2	4	8	....	....	10	2	....	....	....	....	....	....	....	6	9
Rio Grande, Elephant Butte storage	....	....	2	20	4	1	....	3	9	....	1	1	....	....	7	1	1
North Dakota: North Dakota pumping	....	....	2	....	....	....	....	8	....	....	....	....	....	....	1	1	2
Oregon: Umatilla	....	....	11	19	....	....	36	69	3	....	....	....	....	....	7	3	3
Oregon-California: Klamath	2	....	25	22	1	1	57	40	22	1	....	....	....	....	13	6	9
South Dakota: Belle Fourche	....	....	18	5	....	....	17	30	24	....	....	1	1	13	6	16	10
Utah: Strawberry Valley	....	....	8	6	1	....	12	15	8	4	....	....	....	2	1	8	3
Washington:																	
Okanogan	....	2	4	4	1	....	2	14	8	1	....	....	....	....	....	1	3
Yakima—																	
Storage unit	1	2	8	17	1	1	25	28	24	14	....	2	2	29	20	5	4
Sunnyside unit	....	....	12	9	....	....	19	4	11	....	....	....	....	....	4	5	2
Tieton unit	1	....	....	4	....	....	3	6	1	1	....	....	....	....	1	2	3
Wyoming: Shoshone	2	....	25	19	....	....	21	33	12	....	....	....	....	....	....	17	7
INDIAN PROJECTS (see note, p. 679).																	
Montana:																	
Blackfeet	1	1	28	5	....	....	....	28	17	....	....	....	....	....	7	1	1
Flathead	1	....	27	3	....	2	51	56	18	11	....	1	....	....	14	11	9
Fort Peck	1	1	28	4	....	....	103	7	6	3	....	....	....	....	4	9	3
Total, June 30, 1916	52	31	468	421	16	8	886	1,184	451	77	3	13	7	145	197	287	192

Summary of equipment and employees, June 30, 1916—Continued.

State and project.	Number of employees, 1916.													Approximate average wages per day for common labor.
	Average, January to June.						Maximum, January to June.						Average, all June.	
	Government force.				Contractor's force.	Grand total.	Government force.				Contractor's force.	Grand total.		
	Classified, educational.	Classified, noneducational.	Others.	Total.			Classified, educational.	Classified, noneducational.	Others.	Total.				
Arizona: Salt River	20	130	248	398	.....	398	21	131	311	463	.....	463	411	$2.15
Arizona-California: Yuma	13	79	445	537	.....	537	15	85	650	750	.....	750	287	2.00
California: Orland	5	9	37	51	10	61	5	11	69	85	12	97	35	2.50
Colorado:														
Grand Valley	13	25	148	186	50	236	13	30	248	291	90	381	272	2.50
Uncompahgre Valley	13	41	90	144	70	214	14	60	335	409	90	499	183	2.50
Idaho:														
Boise—														
Distribution unit	30	98	226	354	.....	354	36	136	910	1,082	.....	1,082	384	2.40
Storage unit	2	10	23	35	.....	35	2	30	43	75	.....	75	25	2.50
Minidoka	11	81	172	264	.....	264	12	121	203	476	.....	476	316	2.25
Idaho-Wyoming: Jackson Lake enlargement	5	19	107	131	.....	131	6	22	160	188	.....	188	168	2.50
Kansas: Garden City	....	.....	1	1	.....	1	....	.....	1	1	.....	1	1	2.40
Montana:														
Huntley	7	18	140	165	.....	165	7	27	233	267	.....	267	119	2.26
Milk River	18	5	14	37	71	108	21	10	28	59	179	238	195	2.80
Milk River, St. Mary storage	9	15	60	84	.....	84	13	27	148	188	.....	188	171	2.50
Sun River	19	26	68	113	68	181	21	37	165	223	110	333	285	2.50
Montana-North Dakota: Lower Yellowstone	4	5	8	17	.....	17	4	8	48	60	.....	60	32	2.25
Nebraska-Wyoming:														
North Platte (Interstate)	9	39	54	102	1	103	9	76	116	201	3	204	156	2.40
North Platte, Fort Laramie unit	5	12	15	32	127	159	6	19	25	50	242	292	214	2.30
Nevada: Truckee-Carson	7	24	20	51	.....	51	8	26	30	64	.....	64	63	2.50
New Mexico:														
Carlsbad	3	12	128	143	9	152	3	12	164	179	17	196	151	1.76
Hondo	....	1	3	4	1	5	....	1	5	6	1	7	7	1.76
New Mexico-Texas:														
Rio Grande	13	28	200	241	.....	241	13	30	363	406	.....	406	201	1.58
Rio Grande, Elephant Butte storage	13	44	260	317	.....	317	14	54	292	360	.....	360	231	1.72
North Dakota: North Dakota pumping	2	4	11	17	.....	17	2	6	12	20	.....	20	15	2.50
Oklahoma: Lawton	1	2	1	4	.....	4	1	2	1	4	.....	4	4	2.00
Oregon: Umatilla	9	18	100	127	.....	127	10	26	175	211	.....	211	179	2.40
Oregon-California: Klamath	6	28	130	164	4	168	6	46	266	318	16	334	331	2.50
South Dakota: Belle Fourche	8	21	45	74	15	89	8	33	66	107	20	127	89	2.52
Utah: Strawberry Valley	8	18	20	46	.....	46	8	25	80	113	.....	113	46	2.37
Washington:														
Okanogan	4	4	40	48	.....	48	4	7	75	86	.....	86	46	2.20
Yakima—														
Storage unit	10	20	167	197	.....	197	11	47	641	699	.....	699	662	2.60
Sunnyside unit	8	36	79	123	.....	123	9	44	340	393	.....	393	65	2.20
Tieton unit	3	12	10	25	.....	25	3	15	15	33	.....	33	30	2.40
Wyoming: Shoshone	14	28	111	153	42	195	15	44	181	240	46	286	224	2.40
Washington and other offices	196	2	12	210	.....	210	196	2	12	210	.....	210	210	.....
INDIAN PROJECTS (see note).														
Montana:														
Blackfeet	1	1	16	18	.....	18	2	3	45	50	.....	50	23	2.50
Flathead	14	31	51	96	103	199	15	39	87	141	143	284	187	2.65
Fort Peck	4	2	20	26	.....	26	4	3	64	71	.....	71	64	2.50
Total, June 30, 1916	507	948	3,280	4,735	571	5,306	537	1,295	6,607	8,579	969	9,548	6,082	2.33

NOTE.—The Indian projects are separately classified because they are not constructed under the terms of the reclamation law, but in each case are authorized by special statute in connection with the appropriation for the Indian Office.

NOTES.

Arizona, Salt River.—Boat is a launch. Narrow-gauge cars are ore cars. Pumps are hand and power pumps of various sizes.

Arizona-California, Yuma.—In addition, one gasoline motor car. Other carts are road carts. Road grader is a ditch grader. Pumps are of various sizes.

California, Orland.—Narrow-gauge cars are 24-inch.

Colorado, Grand Valley.—Pumps include two 4-inch, one 6-inch, two 10-inch, one 12-inch, one 4 by 6 inch triplex, and one 5 by 8 inch triplex. In addition, 3 water tanks. Wages: Contractors, $2.25; United States, $2.50 per day. Contractors also have 140 horses and mules, 27 plows, 58 scrapers, and 32 wagons.

Idaho, Boise (distribution unit).—In addition, 3 hand concrete mixers, 1 ditcher, 1 sawmill outfit, 9 tongue scrapers, and 1 gasoline speeder. Other excavators are electric. One motor, 1 motorcycle, and 1 light freight wagon sold since last report.

Idaho, Boise (storage unit).—In addition, 1 ice plant, 1 sawmill, and 1 cement plant. Graders are Bagley graders. Pumps comprise 5 duplex steam, one 4-inch, three 8-inch, and one 12-inch. Two cars, 1 air drill, 24 motors, and 3 pumps sold or transferred.

Idaho, Minidoka.—The dredge is a gasoline dredge. Pumps are two 2-inch centrifugal, five 10-inch centrifugal, three 4-inch, and one 8-inch sand pump.

Idaho-Wyoming, Snake River storage.—In addition, 1 disk harrow, 14 steel oil barrels, and 2 ranges.

Idaho-Wyoming, Jackson Lake enlargement.—In addition, 1 tongue scraper. Three slack-line cableways include two 20-horsepower hoists and one 30-horsepower hoist, with boilers and two extra 20-horsepower boilers. The concrete mixer is equipped with engine and boiler. The following equipment is included with the dredge: One 6-inch stage pump direct connected to 25-horsepower engine, one 20-horsepower hoist without boiler, one 15-horsepower cutting-bar engine, six 40-horsepower boilers, one 20-horsepower boiler, 3 boiler-feed pumps, one 12-inch dredging pump direct connected to 200-horsepower engine, 1 stiff-leg derrick.

Montana, Flathead (Indian).—Carts include 7 concrete carts. Drill is a steam drill. Pumps are 1, each, diaphragm, 2½ by 4 inch power, and 3 by 2 by 4 inch duplex steam. Contractors also have large equipment, including 94 horses and mules, 67 scrapers, and 33 wagons.

Montana, Fort Peck.—The pumps are two 3-inch and two 2-inch.

Montana, Huntley.—The other excavator is an Austin excavator. The pumps are one 5-inch and 6 of various sizes.

Montana, Milk River.—The pumps are 2 over 6-inch, four 3 to 6 inch, and 6 under 3-inch. Contractors have large equipment, including 265 horses and mules, 84 scrapers, and 57 wagons.

Montana, Sun River.—The boat is a rowboat. The pumps are three 3 by 4 inch triplex, one 4 by 6 inch triplex, one 3 by 6 inch duplex, one 5¼ by 3½ by 5 inch duplex, three 6 by 4 by 6 inch duplex, two 7 by 6 by 10 inch duplex, 1, each, 2-inch, 3-inch, 4-inch, and 8-inch centrifugal discharge, and two 10-inch centrifugal discharge. In addition, 2 boiler trucks. Contractors also have large equipment, including 160 horses and mules, 41 scrapers, and 43 wagons.

Montana-North Dakota, Lower Yellowstone.—Pumps are one 12-inch, three 3-inch, and 2 lift and tank.

Nebraska-Wyoming, North Platte (Interstate).—In addition, 1 cesspool wagon.

Nebraska-Wyoming, North Platte (Fort Laramie unit).—Contractors also have large equipment, including 171 horses and mules, 69 scrapers, and 49 wagons.

Nevada, Truckee-Carson.—In addition, 3 back-up scrapers and 1 track speeder. Pumps are of miscellaneous sizes. The 35 scrapers are fresnos and stockton. The shovel is electric.

New Mexico, Carlsbad.—The other excavator is an Austin trench excavator. The pumps are two 5 to 7 horsepower, one 3-inch suction, and two 4-inch suction.

New Mexico, Hondo.—The pump is a 3-inch cylinder.

New Mexico-Texas, Rio Grande.—The boat is a rowboat. Car is a push car.

New Mexico-Texas, Elephant Butte storage.—In addition, 1 cement gun, 2 channelers, 2 drill sharpeners, 1 grouting machine, 1 motor car, 114 skips, and one 7-ton machinery wagon. The pumps are of various sizes and classes.

North Dakota, North Dakota pumping.—The boats are pumping barges. Narrow-gauge cars are coal cars.

Oregon, Umatilla.—Narrow-gauge car is a flat car. Pumps are 1 sewer, 3 pitcher, two 4 by 6 inch duplex, six 3 by 2 by 4 inch duplex, 1, each, 4-inch, 5-inch, and 15-inch centrifugal, 2 Red Jacket, and 2 force.

Oregon-California, Klamath.—Pumps are one 6-inch, four 3-inch, and 17 under 3-inch.

South Dakota, Belle Fourche.—Pumps are 1, each, 2½-inch, 3-inch, and 4-inch, and two 2-inch. Contractors' equipment includes 34 horses and mules and 10 scrapers.

Utah, Strawberry Valley.—The other carts and concrete carts.

Washington, Okanogan.—Drills are steam drills. Pile drivers are hammers. Pumps are two 2,700 gallons, 1 No. 2 diaphragm, and one 5-inch piston.

Washington, Yakima storage.—Boats are 2 launches and 6 rowboats.

Washington, Yakima, Sunnyside.—Cars are ore cars. Pumps are one 4 by 6 inch duplex, one 6-inch centrifugal, one 4-inch centrifugal, 3 No. 3 diaphragm, and 3 tank pumps. In addition, 1 champion mowing machine, 1 spring-tooth harrow, 1 disk harrow, one 32-inch crescent band-saw outfit, 3 sets of pipe stock, and dies, 2 triplex chain hoists, 1 power grinder with emery wheel, and one 12-inch by 8-foot engine lathes

Washington, Yakima, Tieton.—In addition, one 1½-ton motor truck. Pumps are two 2-inch, one 3-inch, and one 4-inch.

Wyoming, Shoshone.—In addition, 1 cement gun and 4 rock drills. Cars are 20-inch.

CROP STATISTICS AND OPERATION AND MAINTENANCE DATA.

Acreage cropped and irrigated on reclamation projects in 1915.[1]

State and project.	Cereals.						Other grain and seed.						Hay and forage.							
	Barley.	Corn, Indian.	Oats.	Rye.	Wheat.	Total.	Alfalfa seed.	Clover seed.	Sorghum (grain).	Flaxseed.	Millet seed.	Total.	Alfalfa hay.	Clover hay.	Other hay.	Corn fodder.	Peas.	Other forage.	Pasture.	Total.
Arizona, Salt River	16,459	1,193	2,300	....	11,230	31,182	4,669	......	......	....	....	4,669	78,337	......	1,074	26,332	....	....	36,119	141,862
Arizona-California, Yuma	1,572	262	......	....	2,267	4,101	6,449	......	6,408	....	....	12,857	9,440	......	774	......	....	480	7,898	18,592
California, Orland	......	......	......	....	......	......	......	......	307	....	....	307	5,135	......	......	......	....	....	4,329	9,464
Colorado, Uncompahgre Valley	345	1,167	5,385	33	7,218	14,148	14	1	......	....	....	15	16,611	131	353	282	40	....	1,267	18,684
Idaho:																				
Boise	2,776	6,765	6,974	177	17,504	34,196	246	4,530	......	....	89	4,865	22,259	4,561	331	279	77	....	5,239	32,746
Minidoka—																				
Gravity unit	1,560	362	3,815	128	4,596	10,461	99	174	......	....	....	273	19,225	696	170	80	213	....	5,602	25,986
South Side pumping unit	890	35	2,920	10	8,004	11,859	196	549	......	....	....	745	14,145	371	19	44	583	37	4,045	19,244
Montana:																				
Huntley	415	509	2,514	11	2,887	6,336	2	......	......	....	....	2	5,387	......	440	18	4	....	1,478	7,227
Milk River	28	29	558	....	895	1,510	......	......	......	9	....	9	665	......	1,439	......	....	....	241	2,345
Sun River[2]	245	1	1,033	4	891	2,174	34	......	......	....	3	37	3,706	9	279	5	5	....	213	4,217
Montana-North Dakota, Lower Yellowstone	750	......	1,320	....	4,518	6,588	......	......	......	273	....	273	4,575	......	265	125	....	....	......	4,965
Nebraska-Wyoming, North Platte	2,329	10,343	7,112	168	1,959	21,911	134	......	......	....	106	240	31,788	......	294	103	....	339	3,064	35,588
Nevada, Truckee-Carson	1,733	......	428	....	2,582	4,743	......	......	......	....	....	......	20,343	......	936	......	....	....	11,590	32,869
New Mexico:																				
Carlsbad	60	1,162	194	....	11	1,427	2,070	......	482	....	....	2,552	7,499	......	91	1,870	....	....	486	9,946
Hondo	......	60	10	....	......	70	......	......	9	....	....	9	716	......	50	253	....	....	......	1,019
New Mexico-Texas, Rio Grande	193	3,718	771	....	2,009	6,691	29	......	......	....	....	29	22,152	......	20	879	3	....	845	23,899
Oregon, Umatilla	72	113	......	....	9	194	......	2	10	....	....	12	2,397	5	169	67	....	....	379	3,017
Oregon-California, Klamath	4,639	......	3,634	114	2,617	11,004	......	......	......	....	....	......	8,435	......	1,209	......	....	....	6,159	15,803
South Dakota, Belle Fourche	1,613	4,470	4,440	135	7,747	18,405	284	......	......	48	46	378	16,152	92	2,782	1,866	....	....	3,273	24,165
Washington:																				
Okanogan	......	81	......	....	10	91	......	......	......	....	....	......	1,327	62	157	152	....	....	400	2,098
Yakima—																				
Sunnyside unit	312	8,165	207	....	1,595	10,279	......	......	......	....	....	......	26,042	293	839	1,032	....	....	3,326	31,532
Tieton unit	600	1,350	700	....	2,560	5.210	......	84	......	....	....	84	6,740	485	620	100	1	14	820	8,780
Wyoming, Shoshone	883	......	5,199	....	2,943	9,025	291	197	......	....	....	488	12,185	21	173	42	1	....	1,355	13,777
Total for irrigated areas covered by crop reports[1]	37,474	39,785	49,514	780	84,052	211,605	14,517	5,537	7,216	330	244	27,844	335,161	6,726	12,484	33,529	927	870	98,128	487,825

[1] Data are for calendar year (irrigation season) except on Salt River project. Arizona, data are for corresponding agricultural year October, 1914, to September, 1915. Figures are restricted to irrigated areas except as noted for Sun River project, Montana.

[2] Crop reports covered 164 irrigated farm units, which included 4,243 acres irrigated and cropped, also 2,422 acres cropped without irrigation, all of which are represented in the figures for the separate crops, but not in the total, which is restricted to the irrigated acreage.

Acreage cropped and irrigated on reclamation projects in 1915—Continued.

State and project.	Fruits and nuts.								Vegetables and truck.					
	Apples.	Peaches.	Pears.	Prunes.	Citrus fruit.	Small fruit.	Other.	Total.	Beans.	Onions.	Potatoes, white.	Potatoes, sweet.	Truck.	Total.
Arizona, Salt River					1,054	719	1,944	3,717	1,111		267	59	3,555	4,992
Arizona-California, Yuma								65	324				387	711
California, Orland				40	113	16	206	375	30				96	126
Colorado, Uncompahgre Valley	1,732	174	13	18		66		2,003	148	225	3,775		160	4,308
Idaho:														
Boise	504	133		28		71		736	172	7	1,337	62	734	2,312
Minidoka—														
Gravity unit	238					30		268	25	7	1,358		367	1,757
South Side pumping unit	2							2	85	3	1,623		475	2,136
Montana:														
Huntley								10	4		80		234	318
Milk River											13		10	23
Sun River[2]	2					3		5	2	2	147		79	230
Montana-North Dakota, Lower Yellowstone											60		70	130
Nebraska-Wyoming, North Platte									96	6	1,395		219	1,716
Nevada, Truckee-Carson											196		1,575	1,771
New Mexico:														
Carlsbad		201					5	206	56				42	98
Hondo	61						23	84						
New Mexico-Texas, Rio Grande	166	121	246			132		665	448	7		158	1,252	1,865
Oregon, Umatilla	54	131	9			40		234		2	55		65	122
Oregon-California, Klamath								11			300		114	414
South Dakota, Belle Fourche									36	14	161		133	344
Washington:														
Okanogan	3,628	132	33	7		5	34	3,839	31	1	62		101	195
Yakima—														
Sunnyside unit	8,564	1,059	1,144	206		464		11,437			4,025		1,349	5,374
Tieton unit	1,550	375	310	3		30		2,268	80	50	2,200		255	2,595
Wyoming, Shoshone	1					1		2	12		215		199	426
Total for irrigated areas covered by crop reports[1]	16,502	2,326	1,755	302	1,167	1,577	2,210	25,927	2,610	324	17,269	279	11,481	31,963

State and project.	Miscellaneous.						Duplicated areas.	Total cropped acreage.	Irrigated, no crop.					Total irrigated acreage.
	Beets, sugar.	Cotton.	Hops.	Cane.	Other.	Total.			Young alfalfa.	Young fruit.	Fall plowing.	Miscellaneous.	Duplicated areas.	
Arizona, Salt River		2,160		697	110	2,967	17,557	171,832		1,510		[3] 6,008		[3]179,350
Arizona-California, Yuma		709				709	11,934	25,101				2,756		27,857
California, Orland					12	12	3,354	6,930	542	1,019		437		8,928
Colorado, Uncompahgre Valley	1,723				168	1,891	496	40,553	1,662	1,105	1,047	108	3,012	41,463
Idaho:														
Boise	3			188		191	5,228	69,818	4,369	5,786	125	2,981	6,374	76,705
Minidoka—														
Gravity unit	2,072					2,072	199	40,618	2,910	885	213	1,743	995	45,374
South Side pumping unit	2,597					2,597	193	36,390	724	503	329	1,212	970	38,188
Montana:														
Huntley	5,402					5,402	1,110	18,185		18				18,203
Milk River								3,887				305		4,192
Sun River [2]	2					2		[2] 4,243				18		4,261
Montana-North Dakota, Lower Yellowstone					34	34		11,990				666		12,656
Nebraska-Wyoming, North Platte	7,872				803	8,675		68,130	6,686				4,809	70,007
Nevada, Truckee-Carson							888	38,495				1,800		40,295
New Mexico:														
Carlsbad	7	456		339	5	807	3,714	11,322				2,148		13,470
Hondo				105		105		1,287				7		1,294
New Mexico-Texas, Rio Grande	1			82		83	986	32,246	18	1,260		352		33,876
Oregon, Umatilla					99	99	75	3,603	416	1,060	84	265	122	5,306
Oregon-California, Klamath	22					22		27,254						27,254
South Dakota, Belle Fourche	31				89	120	349	43,063	2,365	52		59	1,472	44,067
Washington:														
Okanogan					3	3	1,412	4,814	302	2,231	26	607	180	7,800
Yakima—														
Sunnyside unit			170			170	3,873	54,919	777	6,108		8,175	3,372	66,607
Tieton unit	1		375		12	388	1,225	18,100	780	5,840	150	350	3,220	22,000
Wyoming, Shoshone	1,115					1,115		24,833	1,410	189	221	86	986	25,753
Total for irrigated areas covered by crop reports [1]	20,848	3,325	545	1,411	1,335	27,464	52,593	757,613	22,961	27,566	2,195	30,083	25,512	814,906
Total irrigated acreage														$814,906
Additional areas irrigated, but not covered by crop reports:														
Colorado, Uncompahgre Valley (under private canals supplied Gunnison Tunnel water)														4,500
Idaho, Boise (Nampa-Meridian and Pioneer Irrigation districts; New York Canal Co.'s lands)														20,422
Nebraska-Wyoming, North Platte (North Platte Canal & Colonization Co.'s lands)														8,050
Utah, Strawberry Valley (lands supplied stored water to supplement insufficient normal flow rights)														8,900
Total irrigated acreage														856,778

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[1] Data are for calendar year (irrigation season) except on Salt River project. Arizona, data are for corresponding agricultural year October, 1914, to September, 1915. Figures are restricted to irrigated areas except as noted for Sun River project, Montana.

[2] Crop reports cover 164 irrigated farm units, which include 4,243 acres irrigated and cropped; also 2,422 acres cropped without irrigation; all of which are represented in the figures for the separate crops, but not in the total, which is restricted to the irrigated acreage.

[3] Includes 4,239 acres, total area of towns contracting for water.

Average yields per acre of irrigated crops harvested on reclamation projects in 1915.[1]

State and project.	Cereals.					Other grain and seed.					Hay and forage.				
	Barley.	Corn, Indian.	Oats.	Rye.	Wheat.	Alfalfa seed.	Clover seed.	Sorghum (grain).	Flaxseed.	Millet seed.	Alfalfa hay.	Clover hay.	Other hay.	Corn fodder.	Peas.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Bushels.*
Arizona, Salt River	20	25	35		18	5					3		2	1	
Arizona-California, Yuma	31	22			18	4.3		36			2.6		1.4		
California, Orland								34			4.4				
Colorado, Uncompahgre Valley	26	31	27	16	25	10	12				2.6	1.7	1.8	3	18
Idaho:															
Boise	26	20	23	11	24	3.2	3.6			4	3.8	1.5	1.4	6	7
Minidoka—															
Gravity unit	38	25	33	20	28	3.0	5.1				3.5	3.3	2.8	4	24
South side pumping unit	25	35	27	100	21	2.3	3.7				3.0	1.7	1.7	2.4	17
Montana:															
Huntley	20	18	30	20	20	1.5					2.8		1.3	3	8
Milk River	22	35	37		27				22		2.2		.9		
Sun River	28	20	35	14	22	1.6				25	2.1	1.7	.9	3	23
Montana-North Dakota, Lower Yellowstone	29		38		18				11		2.3		1	3	
Nebraska-Wyoming, North Platte	37	20	28	9	18	.9				14	2		1	3.8	
Nevada, Truckee-Carson	29		34		21						3		1		
New Mexico:															
Carlsbad	19	16	55		23	2.2		20			2.1		2	.8	
Hondo		14	71					11			2		1.3	1.8	
New Mexico-Texas, Rio Grande	24	27	66		30	5					3.2		2.3	14	12
Oregon, Umatilla	26	33			29		3.5	42			3.8	3.4	1.2	3.8	
Oregon-California, Klamath	27		30	17	18						2.3		1.3		
South Dakota, Belle Fourche	29	14	37	16	17	.2			9	11	2.2	1.8	.9	.6	
Washington:															
Okanogan		28			20						2.8	2	1.5	1.8	
Yakima—															
Sunnyside unit	32	60	60		20						4	3	3	11	
Tieton unit	44	32	45		25		3				3.5	2	2	8	10
Wyoming, Shoshone	19		26		19	1.6	2.8				2.2	1	1.3	7.5	12
Average, all projects	25	31	30	14	21	4.0	3.6	35	11	9	2.9	1.9	1.4	1.8	18

State and project.	Vegetables.				Fruit.						Miscellaneous.			
	Beans.	Onions.	Potatoes, white.	Potatoes, sweet.	Apples.	Peaches.	Pears.	Prunes.	Citrus fruit.	Small fruit.	Beets, sugar.	Cotton.	Hops.	Cane.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Tons.*	*Pounds.*	*Pounds.*	*Tons.*
Arizona, Salt River	16		40	60					1,800	1,800		350		8
Arizona-California, Yuma	5.7											508		
California, Orland	12							2,750	2,600					
Colorado, Uncompahgre Valley	13	253	167		5,740	1,240	1,446	1,400		1,000	7.2			
Idaho:														
Boise	12.5	46	164	21	1,075	1,540		7,920		1,200	5.8			
Minidoka—														
Gravity unit	14.8	46	150		980					765	12			
South side pumping unit	6.1	117	136		250						11			
Montana:														
Huntley	12		117								10			
Milk River			157											
Sun River	10	358	188		1,700						11			
Montana-North Dakota, Lower Yellowstone			90											
Nebraska-Wyoming, North Platte	10	165	181								12			
Nevada, Truckee-Carson			128											
New Mexico:														
Carlsbad	4.5					4,180					5	333		3
Hondo					468									1.5
New Mexico-Texas, Rio Grande	9	13		92	2,000	2,225	2,300			2,150	10			3.4
Oregon, Umatilla		235	108		307	2,120	710			1,070				
Oregon-California, Klamath			71								10			
South Dakota, Belle Fourche	3.6	96	111								10			
Washington:														
Okanogan	6	200	110		2,000	4,900	2,950	4,760		3,160				
Yakima—														
Sunnyside unit			217		2,250	5,900	7,070	12,230					2,400	
Tieton unit	16	90	140		2,500	5,500	1,420	2,000		2,700	10		1,530	
Wyoming, Shoshone	5.1		145		245					1,600	7.3			
Average, all projects	12	204	165	70	2,500	4,600	5,250	10,000	1,850	1,850	11	385	1,800	5.3

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[1] Data are for calendar year (irrigation season) except on Salt River project, Arizona, data are for corresponding agricultural year, October, 1914, to September, 1915.

Total yields of irrigated crops harvested on reclamation projects in 1915.[1]

State and project.	Cereals.						Other grain and seed.						Hay and forage.					
	Barley.	Corn, Indian.	Oats.	Rye.	Wheat.	Total.	Alfalfa seed.	Clover seed.	Sorghum (grain).	Flaxseed.	Millet seed.	Total.	Alfalfa hay.	Clover hay.	Other hay.	Corn fodder.	Peas.	Other forage.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Bush.*	*Tons.*
Arizona, Salt River	329,180	29,825	80,500	......	202,140	641,645	23,345	......	......	......	......	23,345	235,011	......	2,148	26,476	......	......
Arizona-California, Yuma	47,951	5,900	......	......	40,231	94,082	27,817	......	231,185	......	......	259,002	24,227	......	1,110	......	......	1,282
California, Orland	......	......	......	......	......	......	......	......	10,544	......	......	10,544	22,650	......	......	......	......	......
Colorado, Uncompahgre Valley	8,873	36,734	143,240	528	176,731	366,106	140	12	......	......	......	152	43,480	222	650	856	735	......
Idaho:																		
Boise	72,969	197,991	158,472	1,916	418,504	849,852	786	16,090	......	......	364	17,240	85,080	6,743	475	1,718	526	......
Minidoka—																		
Gravity unit	59,631	9,040	126,821	2,569	127,052	325,113	292	880	......	......	......	1,172	67,534	2,286	473	319	5,031	......
South Side pumping unit	22,359	380	78,615	100	172,203	273,657	453	2,042	......	......	......	2,495	42,622	619	33	107	10,191	440
Montana:																		
Huntley	8,196	9,258	75,319	220	57,384	150,377	3	......	......	......	......	3	15,010	......	568	55	32	......
Milk River	609	1,010	20,819	......	24,036	46,474	......	......	......	198	......	198	1,470	......	1,228	......	......	......
Sun River[2]	6,946	20	36,269	56	19,351	62,642	53	......	......	......	75	128	7,888	15	240	15	115	......
Montana-North Dakota, Lower Yellowstone	21,420	......	49,745	......	82,444	153,609	......	......	......	3,108	......	3,108	10,312	......	269	389	......	......
Nebraska-Wyoming, North Platte	87,037	209,626	198,692	1,551	35,514	532,420	121	......	......	......	1,444	1,565	62,491	......	290	394	......	4,628
Nevada, Truckee-Carson	49,585	......	14,375	......	54,065	118,025	......	......	......	......	......	......	53,896	......	830	......	......	......
New Mexico:																		
Carlsbad	1,190	18,915	10,853	......	252	31,210	4,679	......	10,063	......	......	14,742	15,407	......	158	1,438	......	......
Hondo	......	840	710	......	......	1,550	......	......	100	......	......	100	1,465	......	66	426	......	......
New Mexico-Texas, Rio Grande	4,594	101,013	51,094	......	60,605	217,306	145	......	......	......	......	145	70,080	......	47	12,593	38	......
Oregon, Umatilla	1,900	3,778	......	......	260	5,938	......	7	432	......	......	439	9,141	15	210	252	......	......
Oregon-California, Klamath	125,097	......	108,615	1,992	48,245	283,949	......	......	......	......	......	......	19,475	......	1,628	......	......	......
South Dakota, Belle Fourche	47,365	64,098	165,260	2,184	133,248	412,155	65	......	......	408	529	1,002	34,842	170	2,507	1,208	......	......
Washington:																		
Okanogan	......	2,260	......	......	200	2,460	......	......	......	......	......	......	3,725	130	225	268	......	......
Yakima—																		
Sunnyside unit	9,865	489,900	12,420	......	31,900	544,085	......	......	......	......	......	......	104,168	879	2,517	11,352	......	......
Tieton unit	26,000	43,280	31,600	......	63,700	164,580	......	251	......	......	......	251	23,300	970	1,085	800	10	5
Wyoming, Shoshone	16,696	......	132,734	......	55,591	205,021	479	442	......	......	......	921	26,641	22	230	311	3	......
Total	947,463	1,223,868	1,496,153	11,116	1,803,656	5,482,256	58,378	19,724	252,324	3,714	2,412	336,552	979,915	12,071	16,987	58,977	16,681	6,355

State and project.	Vegetables.				Fruit and nuts.								Miscellaneous.			
	Beans.	Onions.	Potatoes, white.	Potatoes, sweet.	Apples.	Peaches.	Pears.	Prunes.	Citrus fruit.	Small fruit.	Other.	Total.	Beets, sugar.	Cotton.	Hops.	Cane.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Tons.*	*Lbs.*	*Lbs.*	*Tons.*
Arizona, Salt River	17,776	......	10,680	3,540	......	......	......	......	1,874,012	1,303,000	7,776,000	10,953,012	......	772,500	......	5,576
Arizona-California, Yuma	1,830	......	......	......	......	......	......	......	......	......	......	150,000	......	359,850	......	......
California, Orland	349	......	......	......	......	......	......	110,000	292,200	30,000	256,900	689,100	......	......	......	......
Colorado, Uncompahgre Valley	1,862	56,950	630,332	......	9,939,500	215,540	18,800	25,100	......	66,475	......	10,265,415	12,355	......	......	......
Idaho:																
Boise	2,144	308	219,460	1,335	542,093	204,240	......	223,700	......	84,790	......	1,054,823	16	......	......	[3] 463
Minidoka—																
Gravity unit	369	337	203,877	......	233,760	......	......	......	......	22,962	......	256,722	25,585	......	......	......
South Side pumping unit	215	352	221,209	......	500	......	......	......	......	......	......	500	27,486	......	......	......
Montana:																
Huntley	49	......	9,360	......	......	......	......	......	......	......	......	9,060	53,911	......	......	......
Milk River	......	......	2,045	......	......	......	......	......	......	......	......	......	......	......	......	......
Sun River [4]	20	717	27,673	......	3,300	......	......	......	......	......	......	3,300	22	......	......	......
Montana-North Dakota, Lower Yellowstone	......	......	5,370	......	......	......	......	......	......	......	......	......	......	......	......	......
Nebraska-Wyoming, North Platte	987	990	251,833	......	......	......	......	......	......	......	......	......	97,753	......	......	......
Nevada, Truckee-Carson	......	......	25,133	......	......	......	......	......	......	......	......	......	......	......	......	......
New Mexico:																
Carlsbad	254	......	......		......	841,000	......	......	......	......	3,500	844,500	35	152,044	......	982
Hondo	......	......	......	......	28,300	......	......	......	......	......	18,000	46,300	......	......	......	160
New Mexico-Texas, Rio Grande	3,899	96	......	14,602	332,000	268,983	567,030	......	......	283,626	......	1,451,639	10	......	......	277
Oregon, Umatilla	......	470	5,970	......	16,400	276,800	6,050	......	......	42,830	......	342,080	......	......	......	......
Oregon-California, Klamath	......	......	21,420	......	......	......	......	......	......	......	......	......	219	......	......	......
South Dakota, Belle Fourche	132	1,350	17,984	......	......	......	......	......	......	......	......	......	311	......	......	......
Washington:																
Okanogan	180	150	7,110	......	7,287,000	647,000	98,800	33,200	......	15,800	145,200	8,227,000	......	......	......	......
Yakima—																
Sunnyside unit	......	......	872,300	......	19,269,000	6,235,320	8,084,600	2,619,440	......	1,000,000	......	37,108,360	......	......	408,000	......
Tieton unit	1,275	4,500	301,800	......	3,878,000	2,069,000	441,500	6,000	......	81,000	......	6,475,500	10	......	573,200	......
Wyoming, Shoshone	59	......	31,272	......	306	......	......	......	......	1,254	......	1,560	8,141	......	......	......
Total	31,400	66,220	2,864,828	19,477	41,530,159	10,657,883	9,216,780	3,017,440	2,166,212	2,931,737	8,199,600	77,878,871	225,854	1,284,394	981,200	7,458

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[1] Data are for calendar year (irrigation season), except on Salt River project, Arizona, data are for corresponding agricultural year, October, 1914, to September, 1915. Figures are restricted to irrigated areas covered by crop reports, excluding about 40,000 acres irrigated but not covered by crop reports and small areas cropped by dry farming on a few projects, except as noted on Sun River project, Montana.

[2] Crop reports covered 164 irrigated farm units, which included 4,243 acres irrigated and cropped; also 2,422 acres cropped without irrigation.

[3] Estimated from yield of 9,251 gallons of sirup; sorghum cane.

[4] Crop reports covered 164 irrigated farm units, which included 4,243 acres irrigated and cropped; also 2,422 acres cropped without irrigation.

Average prices of irrigated crops harvested on reclamation projects in 1915.[1]

State and project.	Cereals.					Other grain and seed.					Hay and forage.				
	Barley.	Corn, Indian.	Oats.	Rye.	Wheat.	Alfalfa seed.	Clover seed.	Sorghum (grain).	Flaxseed.	Millet seed.	Alfalfa hay.	Clover hay.	Other hay.	Corn fodder.	Peas.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Bushels.*
Arizona, Salt River	$0.65	$1.10	$0.75	....	$1.05	$6.60	....	....	....	....	$5.00	....	$10.00	$20.00	....
Arizona-California, Yuma	.66	.64	....	....	.83	8.96	....	$0.63	....	....	7.15	....	8.95	....	....
California, Orland	....	....	....	....	....	....	....	.88	....	....	6.77	....	....	....	....
Colorado, Uncompahgre Valley	.66	.85	.41	$0.88	.88	9.57	$4.08	....	....	....	6.01	$6.58	6.72	4.46	$0.72
Idaho:															
Boise	.53	.60	.40	.60	.75	9.00	10.50	....	....	$2.00	6.00	6.00	6.00	7.00	1.75
Minidoka—															
Gravity unit	.65	1.00	.45	.80	.80	9.00	10.00	....	....	....	6.00	6.00	6.50	5.00	1.80
South side pumping unit	.65	1.00	.45	.80	.80	9.00	10.00	....	....	....	6.00	6.00	6.50	5.00	1.80
Montana:															
Huntley	.53	.80	.49	.50	.87	9.57	....	....	....	....	5.76	....	9.48	3.19	.75
Milk River	.28	.50	.35	....	.78	....	....	....	$1.45	....	7.00	....	8.00	....	....
Sun River	.64	.60	.45	.65	.94	12.04	....	....	....	.80	6.00	8.00	8.36	5.93	1.25
Montana-North Dakota, Lower Yellowstone	.43	....	.29	....	.87	....	....	....	1.82	....	7.74	....	9.22	5.29	....
Nebraska-Wyoming, North Platte	.45	.50	.40	.50	.90	8.00	....	....	....	1.00	5.00	....	6.40	1.00	....
Nevada: Truckee-Carson	.60	....	.56	....	.90	....	....	....	....	....	8.00	....	5.50	....	....
New Mexico:															
Carlsbad	.95	.69	.59	....	1.24	8.14	....	.70	....	....	8.29	....	7.79	4.74	....
Hondo	....	.75	.50	....	....	....	....	.45	....	....	7.91	....	6.06	6.93	....
New Mexico-Texas, Rio Grande	.65	1.00	.50	....	1.00	8.40	....	....	....	....	10.00	....	10.00	3.50	3.36
Oregon, Umatilla	.60	.95	....	....	.80	....	12.50	.77	....	....	8.07	8.00	6.66	3.69	....
Oregon-California, Klamath	.60	....	.40	.85	1.00	....	....	....	....	....	8.00	....	8.00	....	....
South Dakota, Belle Fourche	.65	.50	.40	.90	.80	10.00	....	....	1.80	1.00	4.50	4.00	10.00	5.00	....
Washington:															
Okanogan	....	.60	....	....	.75	....	....	....	....	....	9.00	10.00	10.00	7.50	....
Yakima—															
Sunnyside unit	.65	.60	.45	....	.90	....	....	....	....	....	9.00	10.00	9.00	6.00	....
Tieton unit	.60	.75	.40	....	.80	....	10.00	....	....	....	7.50	6.00	8.00	3.00	3.00
Wyoming, Shoshone	.75	....	.50	....	.75	9.00	9.00	....	....	....	7.00	7.00	7.00	7.00	2.40
Average, all projects	.61	.64	.44	.75	.85	7.96	10.36	.64	1.80	1.14	6.60	6.35	8.53	11.58	1.75

State and project.	Vegetables and truck.				Fruit.						Miscellaneous.			
	Beans.	Onions.	Potatoes, white.	Potatoes, sweet.	Apples.	Peaches.	Pears	Prunes.	Citrus fruit.	Small fruit.	Beets, sugar.	Cotton.	Hops.	Cane.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Tons.*	*Tons.*	*Pounds.*	*Tons.*
Arizona, Salt River	$2.40		$1.00	$0.60					$0.04	$0.06		[2] $0.20		$4.00
Arizona-California, Yuma	2.99											.11		
California, Orland	2.92								.017	.05				
Colorado, Uncompahgre Valley	2.56	$0.58	.39		$0.014	$0.018	$0.03	$0.022		.073	$5.03			
Idaho:														
Boise	3.00	.80	.60	2.50	.02	.01		.0075		.05	5.00			
Minidoka—														
Gravity unit	3.00	1.00	.45		.02					.05	5.00			
South side pumping unit	3.00	1.00	.45		.02						5.00			
Montana:														
Huntley	2.14		.72								5.92			
Milk River			.60											
Sun River	.50	1.21	.50		.03						5.00			
Montana-North Dakota, Lower Yellowstone			.57											
Nebraska-Wyoming, North Platte	3.90	1.00	.40								5.50			
Nevada: Truckee-Carson			.75											
New Mexico:														
Carlsbad	2.10					.01					4.85	.12		5.02
Hondo					.014									7.34
New Mexico-Texas, Rio Grande	2.40	2.50		.40	.02	.01	.025			.06	5.00			16.90
Oregon, Umatilla		.60	.61		.02	.007	.03			.05				
Oregon-California, Klamath			.70								5.00			
South Dakota, Belle Fourche	3.00	.80	.50								4.00			
Washington:														
Okanogan	3.60	.90	.90		.025	.01	.025	.01		.03				
Yakima—														
Sunnyside unit			.45		.021	.0125	.016	.024					$0.11	
Tieton unit	2.40	.50	.40		.03	.01	.02	.04		.05	10.00		.10	
Wyoming, Shoshone	2.40		.40		.04					.04	6.00			
Average, all projects	2.55	.60	.45	.58	.02	.012	.017	.024	.037	.06	5.50	.16	.10	4.62

[1] Data are for calendar year (irrigation season) except on Salt River project, Arizona, data are for corresponding agricultural year, October, 1914, to September, 1915. These figures are intended to show the value received by the farmer for his crops, whether sold on the farm or in town, with or without baling, boxing, etc. If fed by the farmer the crop is given a value representing the selling price on the farm.

[2] Long staple; short staple, $0.08.

Value of irrigated crops harvested on reclamation projects in 1915.[1]

State and project.	Cereals.						Other grain and seed.					
	Barley.	Corn, Indian.	Oats.	Rye.	Wheat.	Total.	Alfalfa seed.	Clover seed.	Sorghum (grain).	Flaxseed.	Millet seed.	Total.
Arizona, Salt River	$213,967	$32,807	$60,375		$212,247	$519,396	$154,077					$154,077
Arizona-California, Yuma	31,924	3,786			33,211	68,921	249,331		$144,892			394,223
California, Orland									9,211			9,211
Colorado, Uncompahgre Valley	5,887	31,275	59,176	$466	155,373	252,177	1,340	$49				1,389
Idaho:												
Boise	38,674	118,795	63,389	1,150	313,878	535,886	7,079	169,037			$728	176,844
Minidoka—												
Gravity unit	38,760	9,040	57,069	2,055	101,642	208,566	2,628	8,800				11,428
South side pumping unit	14,533	380	35,377	80	137,762	188,132	4,077	20,420				24,497
Montana:												
Huntley	4,344	7,406	36,906	110	49,695	98,461	29					29
Milk River	170	505	7,297		18,748	26,720				$287		287
Sun River[2]	4,438	12	16,321	36	18,180	38,987	638				60	698
Montana-North Dakota, Lower Yellowstone	9,161		14,579		71,897	95,637				5,659		5,659
Nebraska-Wyoming, North Platte	39,167	104,813	79,477	776	31,098	255,331	968				1,444	2,412
Nevada, Truckee-Carson	29,750		8,050		48,660	86,460						
New Mexico:												
Carlsbad	1,140	13,092	6,508		313	21,053	38,082		7,062			45,144
Hondo		630	355			985			45			45
New Mexico-Texas, Rio Grande	2,986	101,013	25,547		60,605	190,151	1,218					1,218
Oregon, Umatilla	1,140	3,604			208	4,952		87	331			418
Oregon-California, Klamath	75,058		43,446	1,693	48,245	168,442						
South Dakota, Belle Fourche	30,787	32,049	66,104	1,966	106,598	237,504	650			735	529	1,914
Washington:												
Okanogan		1,356			150	1,506						
Yakima—												
Sunnyside unit	6,412	293,940	5,589		28,710	334,651						
Tieton unit	15,600	32,460	12,640		50,960	111,660		2,510				2,510
Wyoming, Shoshone	12,522		66,367		41,693	120,582	4,311	3,978				8,289
Total for irrigated areas covered by crop reports	576,420	786,963	664,572	8,332	1,529,873	3,566,160	464,428	204,881	161,541	6,681	2,761	840,292

State and project.	Hay and forage.								Vegetables and truck.					
	Alfalfa hay.	Clover hay.	Other hay.	Corn fodder.	Peas.	Other forage.	Pasture.	Total.	Beans.	Onions.	Potatoes, white.	Potatoes, sweet.	Truck.	Total.
Arizona, Salt River	$1,175,055		$21,480	$526,496			$433,428	$2,156,459	$42,662		$10,680	$2,124	$305,322	$360,788
Arizona-California, Yuma	173,297		9,937			$6,673	95,361	285,268	5,471				30,197	35,668
California, Orland	153,322						22,323	175,645	1,021				6,794	7,815
Colorado, Uncompahgre Valley	261,361	$1,460	4,368	3,815	$530		11,020	282,554	4,773	$32,888	244,961		9,221	291,843
Idaho:														
Boise	510,480	40,458	2,851	12,024	920		53,366	620,099	6,431	247	131,676	3,337	28,846	170,537
Minidoka—														
Gravity unit	405,204	13,716	3,074	1,595	9,056		43,559	476,204	1,107	337	91,745		16,343	109,532
South side pumping unit	255,732	3,714	215	535	18,344	1,540	37,950	318,030	645	352	99,544		17,397	117,938
Montana:														
Huntley	86,458		5,385	175	24		5,557	97,599	105		6,739		13,050	19,894
Milk River	10,290		9,824				1,751	21,865			1,227		1,150	2,377
Sun River [2]	46,868	117	2,007	89	144		2,245	51,470	59	809	13,837		7,947	22,712
Montana-North Dakota, Lower Yellowstone	79,771		2,480	2,059				84,310			3,059		4,641	7,700
Nebraska-Wyoming, North Platte	312,455		1,861	394		13,754	24,512	352,976	3,849	990	100,733		4,071	109,643
Nevada, Truckee-Carson	431,168		4,570				23,315	459,053			18,850		28,160	47,010
New Mexico:														
Carlsbad	127,757		1,232	6,819			4,568	140,376	529				2,080	2,609
Hondo	11,590		400	2,953				14,943						
New Mexico-Texas, Rio Grande	700,800		470	44,075	128		4,225	749,698	9,358	240		5,841	104,925	120,364
Oregon, Umatilla	73,768	124	1,397	930			5,772	81,991		282	3,642		5,094	9,018
Oregon-California, Klamath	155,800		13,024				18,476	187,300			14,994		4,917	19,911
South Dakota, Belle Fourche	156,789	680	25,070	6,040			14,105	202,684	396	1,080	8,992		7,690	18,158
Washington:														
Okanogan	33,525	1,300	2,250	2,010			4,000	43,085	648	135	6,399		8,959	16,141
Yakima—														
Sunnyside unit	937,512	8,790	22,653	68,112			66,520	1,103,587			392,535		134,900	527,435
Tieton unit	174,750	5,820	8,680	2,400	30	420	12,300	204,400	3,060	2,250	120,720		16,180	142,210
Wyoming, Shoshone	186,487	154	1,610	2,177	7		17,779	208,214	143		12,509		11,386	24,038
Total for irrigated areas covered by crop reports	6,460,239	76,333	144,838	682,698	29,183	22,387	902,132	8,317,810	80,257	39,670	1,282,842	11,302	769,270	2,183,341

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[1] Data are for calendar year (irrigation season) except on Salt River project, Arizona, data are for corresponding agricultural year, October, 1914, to September, 1915. Figures are restricted to irrigated areas covered by crop reports, excluding about 40,000 acres irrigated but not covered by crop reports and small areas cropped by dry farming on a few projects, except as noted on Sun River project, Montana. All figures are intended to show the value received by the farmer for his crops, whether sold on the farm or in town, with or without baling, boxing, etc. If fed by the farmer, the crop is given a value representing the selling price on the farm.

[2] Crop reports covered 164 irrigated farm units, which included 4,243 acres cropped with irrigation and 2,422 acres cropped without irrigation. Above figures for separate crops include both irrigated and not irrigated. Figure for total is estimated value of irrigated crops only.

Value of irrigated crops harvested on reclamation projects in 1915—Continued.

State and project.	Fruit and nuts.								Miscellaneous.						Total.
	Apples.	Peaches.	Pears.	Prunes.	Citrus fruit.	Small fruit.	Other.	Total.	Beets, sugar.	Cotton.	Hops.	Cane.	Other.	Total	
Arizona, Salt River					$74,960	$75,480	$155,520	$305,960		$138,660		$22,304	$4,125	$165,089	$3,661,769
Arizona-California, Yuma								6,275		43,666				43,666	[1]873,721
California, Orland				$5,500	4,898	2,204	9,549	22,151					5,600	5,600	220,422
Colorado, Uncompahgre Valley	$138,413	$3,938	$567	557		4,841		148,316	$62,205				6,431	68,636	1,044,915
Idaho:															
Boise	10,842	2,042		1,678		4,240		18,802	80			4,625		4,705	1,526,873
Minidoka—															
Gravity unit	4,675					1,148		5,823	127,925					127,925	939,478
South side pumping unit	10							10	137,430					137,430	786,087
Montana:															
Huntley								227	319,153					319,153	535,363
Milk River															51,249
Sun River [2]	97					1,055		1,152	110					110	[2]80,000
Montana-North Dakota, Lower Yellowstone													705	705	194,011
Nebraska-Wyoming, North Platte									537,641				5,614	543,255	1,263,617
Nevada, Truckee-Carson															592,523
New Mexico:															
Carlsbad		8,822					175	8,997	170	22,345		4,930	60	27,505	245,684
Hondo	410						220	630				1,175		1,175	17,778
New Mexico-Texas, Rio Grande	6,640	2,690	14,176			17,017		40,523	50			1,385		1,435	1,103,389
Oregon, Umatilla	328	1,937	181			2,099		4,545					3,729	3,729	104,653
Oregon-California, Klamath								740	1,095					1,095	377,488
South Dakota, Belle Fourche									1,244				546	1,790	462,050
Washington:															
Okanogan	182,175	6,470	2,470	332		474	1,452	193,373					320	320	254,425
Yakima—															
Sunnyside unit	404,649	77,942	129,353	62,869		64,960		739,773			$44,880			44,880	2,750,326
Tieton unit	116,340	20,690	8,830	240		4,050		150,150	100		57,320		300	57,720	668,650
Wyoming, Shoshone	12					50		62	48,846					48,846	410,031
Total for irrigated areas covered by crop reports	864,591	124,531	155,577	71,176	79,858	177,618	166,916	1,647,509	1,236,049	204,671	102,200	34,419	27,430	1,604,769	18,164,452

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[1] Includes $39,700 not listed under any crop, being estimated value derived from feeding alfalfa straw after threshing for seed, pasturing stalk land, etc.

[2] Crop reports covered 164 irrigated farm units, which included 4,243 acres cropped with irrigation and 2,422 acres cropped without irrigation. Above figures for separate crops include both irrigated and not irrigated. Figure for total is estimated value of irrigated crop only.

Average value per acre of irrigated crops harvested on reclammation projects in 1915.[1]

State and project.	Cereals.						Other grain and seed.					
	Barley.	Corn, Indian.	Oats.	Rye.	Wheat.	All.	Alfalfa seed.	Clover seed.	Sorghum (grain).	Flaxseed.	Millet seed.	All.
Arizona, Salt River	$13.00	$27.50	$26.25		$18.90	$16.65	$33.00					$33.00
Arizona-California, Yuma	20.31	14.45			14.65	16.80	38.66		$22.61			30.65
California, Orland									30.00			30.00
Colorado, Uncompahgre Valley	17.06	26.80	10.99	$14.12	21.53	17.80	95.71	$49.00				92.60
Idaho:												
Boise	13.93	17.56	9.09	6.47	17.93	15.70	28.71	37.40			$8.23	33.70
Minidoka—												
Gravity unit	24.85	24.97	14.99	16.05	22.11	19.90	26.55	50.57				41.90
South-side pumping unit	16.33	10.86	12.12	8.00	17.21	15.85	20.80	37.19				32.90
Montana:												
Huntley	10.47	14.55	14.68	10.00	17.20	15.55	14.50					14.50
Milk River	6.08	17.41	13.08		20.95	17.70				$31.90		31.90
Sun River	18.08	12.00	15.80	9.10	20.39	17.90	18.76				20.00	18.90
Montana-North Dakota, Lower Yellowstone	12.21		11.04		15.91	14.50				20.73		20.73
Nebraska-Wyoming, North Platte	16.82	10.13	11.18	4.62	16.00	11.65	7.22				13.62	10.00
Nevada, Truckee-Carson	17.16		18.80		18.85	18.20						
New Mexico:												
Carlsbad	19.00	11.26	33.54		28.45	14.75	18.40		14.65			17.70
Hondo		10.50	35.50			14.00			5.00			5.00
New Mexico-Texas, Rio Grande	15.47	27.17	33.14		30.17	28.50	42.00					42.00
Oregon, Umatilla	15.83	31.81			23.11	25.50		43.75	32.12			34.80
Oregon-California, Klamath	16.20		11.50	14.80	18.40	15.30						
South Dakota, Belle Fourche	19.05	7.15	14.90	14.58	13.76	12.90	2.00			15.30	11.50	5.06
Washington:												
Okanogan		16.70			15.00	16.50						
Yakima—												
Sunnyside unit	20.54	36.00	27.00		18.00	32.50						
Tieton unit	26.00	24.00	18.00		20.00	21.40		30.00				30.00
Wyoming, Shoshone	14.18		12.77		14.17	13.40	14.79	20.24				17.00
Average all projects	15.00	20.00	13.00	11.00	18.00	17.00	32.00	37.00	22.00	20.00	11.00	30.00

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[1] Data are for calendar year (irrigation season), except on Salt River project data are for corresponding agricultural year, October, 1914, to September, 1915. These figures are intended to show the value received by the farmer for his crops, whether sold on the farm or in town, with or without baling, boxing, etc. If fed by the farmer, the crop is given a value representing the selling price on the farm.

Average value per acre of irrigated crops harvested on reclamation projects in 1915—Continued.

State and project.	Hay and forage.							Vegetables and truck.					
	Alfalfa hay.	Clover hay.	Other hay.	Corn fodder.	Peas.	Pasture.[1]	All.	Beans.	Onions.	Potatoes, white.	Potatoes, sweet.	Truck.	All.
Arizona, Salt River	$15.00	....	$20.00	$20.00	....	$12.00	$15.20	$38.40	....	$40.00	$36.00	$85.90	$72.00
Arizona-California, Yuma	18.36	....	12.83	....	....	12.07	15.35	16.89	....	....	....	78.01	50.00
California, Orland	29.85	....	....	....	....	5.16	18.55	34.03	....	....	....	70.77	62.00
Colorado, Uncompahgre Valley	15.73	$11.15	12.37	13.53	$13.25	8.69	15.10	82.25	$146.00	64.89	....	57.63	68.00
Idaho:													
Boise	22.93	8.87	8.60	43.02	11.95	10.19	18.60	37.39	36.54	98.49	53.73	39.30	74.00
Minidoka—													
Gravity unit	21.07	19.71	18.08	19.94	42.51	7.77	18.30	44.28	48.14	67.56	....	44.53	62.00
South-side pumping unit	18.08	10.00	11.28	12.16	31.46	9.38	16.50	18.43	117.33	61.33	....	36.63	55.00
Montana:													
Huntley	16.35	....	12.24	9.72	6.00	3.76	13.50	26.25	....	84.24	....	55.77	56.00
Milk River	15.48	....	6.12	....	....	7.27	9.30	....	....	94.38	....	115.00	103.00
Sun River	12.65	13.00	7.21	18.00	28.75	10.54	12.20	33.43	435.00	94.13	....	101.00	99.00
Montana-North Dakota, Lower Yellowstone	18.07	....	9.36	16.47	....	....	17.00	....	....	50.98	....	66.30	59.00
Nebraska-Wyoming, North Platte	9.83	....	6.33	3.82	....	8.00	9.90	40.09	165.00	72.21	....	18.58	64.00
Nevada, Truckee-Carson	23.36	....	4.88	....	....	....	14.00	....	....	96.17	....	17.87	27.00
New Mexico:													
Carlsbad	17.04	....	13.53	3.64	....	9.39	14.10	9.45	....	....	....	49.52	27.00
Hondo	16.18	....	8.00	11.67	....	....	14.66	....	....	....	....	....	....
New Mexico-Texas, Rio Grande	31.60	....	23.50	50.16	39.28	5.00	31.40	20.88	33.10	....	36.97	83.80	66.00
Oregon, Umatilla	30.78	27.55	8.24	13.84	....	15.25	27.20	....	141.00	65.57	....	78.40	74.00
Oregon-California, Klamath	18.50	....	10.80	....	....	3.00	11.85	....	....	50.00	....	43.00	48.00
South Dakota, Belle Fourche	9.90	7.20	9.00	3.00	....	4.32	8.40	11.00	77.10	55.75	....	57.80	53.00
Washington:													
Okanogan	25.20	21.00	14.30	13.20	....	10.00	20.90	20.90	180.00	102.80	....	87.00	83.00
Yakima—													
Sunnyside unit	36.00	30.00	27.00	66.00	....	20.00	35.00	....	....	97.50	....	100.00	98.00
Tieton unit	26.00	12.00	14.00	24.00	30.00	15.00	23.30	38.00	45.00	55.00	....	61.10	55.00
Wyoming, Shoshone	15.30	7.16	9.31	52.46	28.80	13.12	15.10	12.15	....	58.11	....	57.36	56.00
Average all projects	19.00	11.00	12.00	20.00	31.00	9.00	17.00	31.00	122.00	74.00	41.00	67.00	68.00

State and project.	Fruit and nuts.								Miscellaneous.					All crops.
	Apples.	Peaches.	Pears.	Prunes.	Citrus fruit.	Small fruit.	Other.	All.	Beets, sugar.	Cotton.	Hops.	Cane.	Other.	
Arizona, Salt River	......	......	......	......	$71.12	$105.00	$80.00	$82.00	......	[2] $64.20	......	$32.00	$37.50	$21.31
Arizona-California, Yuma	......	......	......	......	......	......	......	97.00	......	61.59	......	......	......	34.81
California, Orland	......	......	......	......	43.35	138.00	46.35	59.00	......	......	......	......	467.00	31.81
Colorado, Uncompahgre Valley	$79.91	$22.64	$43.62	$30.94	......	73.34	......	74.00	$36.10	......	......	......	38.28	25.76
Idaho:														
Boise	21.51	15.41	......	59.39	......	60.03	......	26.00	29.09	......	......	24.56	......	21.87
Minidoka—														
Gravity unit	19.65	......	......	......	......	38.26	......	22.00	61.74	......	......	......	......	23.13
South-side pumping unit	5.00	......	......	......	......	......	......	5.00	52.92	......	......	......	......	......
Montana:														
Huntley	......	......	......	......	......	......	......	23.00	59.08	......	......	......	......	29.41
Milk River	......	......	......	......	......	......	......	......	......	......	......	......	......	13.18
Sun River	48.50	......	......	......	......	301.00	......	230.00	55.00	......	......	......	......	17.29
Montana-North Dakota, Lower Yellowstone	......	......	......	......	......	......	......	......	......	......	......	......	20.74	16.18
Nebraska-Wyoming, North Platte	......	......	......	......	......	......	......	......	68.30	......	......	......	6.99	18.55
Nevada, Truckee-Carson	......	......	......	......	......	......	......	......	......	......	......	......	......	[3] 15.39
New Mexico:														
Carlsbad	......	43.89	......	......	......	......	35.00	43.00	24.29	48.99	......	14.54	12.00	21.70
Hondo	6.72	......	......	......	......	......	9.56	8.00	......	......	......	11.19	......	13.81
New Mexico-Texas, Rio Grande	40.00	22.23	57.63	......	......	129.00	......	61.00	50.00	......	......	16.90	......	34.22
Oregon, Umatilla	6.13	14.83	21.35	......	......	50.12	......	20.00	......	......	......	......	37.49	29.04
Oregon-California, Klamath	......	......	......	......	......	......	......	70.00	48.70	......	......	......		13.85
South Dakota, Belle Fourche	......	......	......	......	......	......	......	......	40.00	......	......	......	6.13	10.72
Washington:														
Okanogan	50.20	49.00	70.70	47.40	......	94.80	42.70	50.00	......	......	......	......	107.00	52.60
Yakima—														
Sunnyside unit	47.25	73.60	113.00	305.00	......	140.00	......	65.00	......	......	$264.00	......	......	50.08
Tieton unit	75.00	55.00	28.00	80.00	......	135.00	......	66.00	100.00	......	153.00	......	25.00	37.00
Wyoming, Shoshone	9.79	......	......	......	......	40.13	......	31.00	43.81	......	......	......	......	16.51
Average all projects	52.00	54.00	56.00	235.00	68.00	113.00	75.00	63.00	59.00	62.00	188.00	24.00	21.00	24.00

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[1] Figures for pasture on different projects are not comparable. The larger amounts represent value of alfalfa or other cultivated pasture for the season, while smaller values are native grass, etc., or represent part-season pasture of fields also cut for hay.

[2] Long staple, $70; short staple, $32.

[3] $22.62 eliminating native pasture and other areas not in full production.

FINANCIAL STATEMENTS.

ASSETS, LIABILITIES, RESERVES, AND CAPITAL.

Assets, liabilities, reserves, and capital, Salt River project, to June 30, 1916.

ASSETS.

Cash:			
Cash in special deposit account			$2,301.22
Inventory of stock on hand:			
Stores issued and not used		$905.92	
Storehouse stock		83,620.47	
Cement		11,092.36	
Structural iron and steel		11,377.39	
Lumber		4,887.76	
Explosives		469.90	
Forage in stock		1,382.69	
Fuel		1,180.87	
Goods in transit		1,827.30	
Freight and handling on inventory property		[1] 26.63	
			116,718.03
Accounts receivable:			
Uncollected rentals of power and light		35,112.55	
Uncollected rentals of irrigation water		8,758.22	
Other uncollected items unclassified		13,890.49	
Unadjusted transfers to other projects		261.87	
			58,023.13
Construction work in process:			
Gross cost of construction of project to date	$11,765,760.34		
Gross operation and maintenance cost during construction	1,928,935.65		
Gross cost of producing commercial power during construction	539,970.64		
Plant accounts	44,910.72		
		14,279,577.35	
Less revenues earned during construction—			
Rentals of buildings	15,783.88		
Rentals of grazing and farming lands	19,107.14		
Rentals of power and light	845,395.58		
Rentals of irrigation water	1,638,665.58		
Contractors' freight refunds	19,269.63		
Forfeitures by defaulting bidders and contractors	7,816.30		
Other revenues, unclassified	56,941.58		
Less cost adjustments—			
Profit on mess-house operations	18,254.76		
Profit on mercantile store operations	2,609.37		
Loss on hospital operations	276.11		
Plant accounts	320,484.56		
Total deductions		2,944,052.27	
Net cost of construction of project to date			11,335,525.08
Total assets			11,512,567.46

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[1] Deduct.

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor	$23,784.13		
Unpaid purchases	9,576.31		
Unpaid freight and express charges	12,491.96		
Unpaid passenger fares	283.66		
Unpaid agreements to purchase real property	1,622.95		
Guaranteed and special deposits	2,301.22		
		$50,060.23	
Other unpaid items unclassified		145,351.63	
			$195,411.86
Reserves for repayment to reclamation fund of cost of project:			
Construction charges paid in advance by water-right applicants			867,046.37
Capital investment:			
Disbursement vouchers	$13,259,185.45		
Transfer vouchers received from other projects	426,106.93		
		$13,685,292.38	
Less—			
Collections	3,170,691.15		
Transfer vouchers issued to other projects	64,492.00		
Net investment		3,235,183.15	
			10,450,109.23
Total liabilities, reserves, and capital investments of the Government			11,512,567.46

Assets, liabilities, reserves, and capital, Yuma project, to June 30, 1916.

ASSETS.

Cash:			
Cash in special deposit account			$363.81
Inventory of stock on hand:			
Storehouse stock		$33,304.48	
Cement		618.05	
Lumber		2,384.39	
Forage in stock		1,370.05	
Fuel		38.65	
Freight and handling on inventory property		1,169.74	
			38,885.36
Accounts receivable:			
Construction charges due and uncollected from water-right applicants		131,608.18	
Construction charges unaccrued on contracts with water-right applicants		326,090.54	
Operation and maintenance charges due and uncollected from water-right applicants		9,777.77	
Uncollected rentals of irrigation water		5,469.06	
Uncollected freight refunds		.25	
Other uncollected items unclassified		218.15	
Unadjusted transfers to other projects		2,358.79	
			475,522.74
Construction work in process:			
Gross cost of construction of project to date	$7,880,563.09		
Gross operation and maintenance cost during construction	572,234.76		
Plant accounts	209,404.98		
		8,662,202.83	
Less revenues earned during construction—			
Rentals of buildings	4,223.73		
Rentals of irrigation water	279,440.50		
Contractors' freight refunds	18,506.11		
Other revenues, unclassified	6.25		

Construction work in process—Continued.			
Less cost adjustments—			
Profit on mess-house operations	$864.66		
Profit on mercantile store operations	66,451.65		
Profit on hospital operations	2,063.47		
Profit on railroad operations	3,849.73		
Total deductions		$367,706.64	
Net cost of construction of project to date			$8,294,496.19
Deferred operation and maintenance charges			121,554.91
Total assets			8,930,823.01

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor		$25,310.13	
Unpaid purchases		13,758.45	
Unpaid freight and express charges		20,174.89	
Unpaid passenger fares		568.32	
Unredeemed coupon books		383.50	
Unredeemed meal tickets		2,826.35	
			63,021.64
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		727,697.96	
Construction charges paid and forfeited by water-right applicants		754.00	
Penalties paid on construction charges by water-right applicants		99.49	
			728,551.45
Capital investment:			
Disbursement vouchers	$8,728,685.97		
Transfer vouchers received from other projects	257,617.45		
		8,986,303.42	
Less—			
Collections	752,391.47		
Transfer vouchers issued to other projects	94,662.03		
		847,053.50	
Net investment			8,139,249.92
Total liabilities, reserves, and capital investments of the Government			8,930,823.01

Operating expenses and revenues, Yuma project, to June 30, 1916.

EXPENSES.

Canal system:		
Operation	$5,822.98	
Maintenance	39,249.25	
		$45,072.23
Lateral system:		
Operation	40,201.96	
Maintenance	93,593.91	
		133,795.87
Drainage system:		
Operation	6,280.30	
Maintenance	6,977.36	
		13,257.66

Undistributed expenses:		
Operation	$1,137.88	
Maintenance	3,076.51	
		$4,214.39
Total		196,340.15

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	70,657.54
Operation and maintenance charges paid and forfeited by water-right applicants	251.00
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	40.44
Rental of land and buildings during operating period	3,049.14
Rental of grazing and farming lands during operating period	864.00
Rental of telephone and tolls during operating period	4.00
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	121,554.91
Total	196,340.15

Assets, liabilities, reserves, and capital, Orland project, to June 30, 1916.

ASSETS.

Inventory of stock on hand:			
Storehouse stock		$778.76	
Cement		1,495.95	
Structural iron and steel		158.24	
Lumber		298.04	
Explosives		209.57	
Forage		31.97	
Fuel		151.87	
Products of local operations		304.24	
Freight and handling on inventory property		136.48	
			$3,565.12
Construction work in process:			
Gross cost of construction of project to date	$876,396.31		
Gross operation and maintenance cost during construction	99,154.23		
Plant accounts	987.94		
		976,538.48	
Less revenues earned during construction—			
Rental of buildings	984.00		
Rental of grazing and farming lands	3,217.00		
Rental of irrigation water	95,818.60		
Contractors' freight refunds	1,829.82		
Forfeitures by defaulting bidders and contractors	2,115.00		
Other revenues, unclassified	1,787.51		
Less cost adjustments—			
Profit on mess-house operations	14.97		
Profit on hospital operations	703.33		
Total deductions		106,470.23	
Net cost of construction of project to date			870,068.25
Total assets			873,633.37

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor		$2,514.19	
Unpaid purchases		874.50	
Unpaid freight and express charges		714.14	
Unpaid passenger fares		1.00	
Unpaid agreements to purchase real property		5.00	
Unredeemed meal tickets		48.00	
			$4,156.83
Capital investment:			
Disbursement vouchers	$936,399.75		
Appropriation transfer vouchers received	4,409.01		
Transfer vouchers received from other projects	44,383.63		
		985,192.39	
Less—			
Collections	110,572.48		
Transfer vouchers issued to other projects	5,143.37		
		115,715.85	
Net investment			869,476.54
Total liabilities, reserves, and capital investments of the Government			873,633.37

Assets, liabilities, reserves, and capital, Grand Valley project, to June 30, 1916.

ASSETS.

Cash:			
In other employees' hands, awaiting transfer to special fiscal agents		$0.25	
Cash in special deposit account		218.72	
			$218.97
Inventory of stock on hand:			
Stores issued and not used		48.37	
Storehouse stock		25,020.96	
Cement		387.64	
Structural iron and steel		174.85	
Lumber		15,616.72	
Explosives		102.25	
Forage in stock		1,403.38	
Fuel		89.68	
Goods in transit		637.97	
Freight and handling on inventory property		531.58	
			44,013.40
Accounts receivable:			
Uncollected rentals of grazing and farming lands			20.00
Construction work contracted:			
Unearned value of construction work contracted		25,330.60	
Estimated engineering expenses on construction work contracted		1,200.00	
			26,530.60
Construction work in process:			
Gross cost of construction of project to date	$2,805,411.93		
Gross operation and maintenance cost during construction	4,650.40		
Plant accounts	14,476.90		
		2,824,539.23	
Less revenues earned during construction—			
Rentals of buildings	1,327.86		
Rentals of grazing and farming lands	1,471.74		
Rentals of power and light	259.92		

Construction work in process—Contd.			
Less revenues earned during construction—Continued.			
Rentals of irrigation water	$1,187.80		
Rentals of telephones and tolls	15.65		
Forfeitures by defaulting bidders and contractors	230.00		
Other revenues, unclassified	4.50		
Less cost adjustments—			
Profit on mess-house operations	10,667.23		
Profit on mercantile-store operations	1,208.05		
Profit on hospital operations	3,196.74		
Total deductions		$19,569.49	
Net cost of construction of project to date			$2,804,969.74
Total assets			2,875,752.71

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid progress earnings under construction contracts		$11,231.00	
Unpaid contract holdbacks		3,713.75	
Unpaid labor		12,100.25	
Unpaid purchases		11,888.17	
Unpaid freight and express charges		16,472.89	
Unpaid passenger fares		21.40	
Unpaid agreements to purchase real property		540.00	
Guarantee and special deposits		218.72	
Other unpaid items unclassified		138.25	
			56,324.43
Contingent obligations:			
Unearned value of construction work contracted		25,330.60	
Estimated engineering expenses on construction work contracted		1,200.00	
			26,530.60
Capital investment:			
Disbursement vouchers	$2,684,252.92		
Transfer vouchers received from other projects	127,020.98		
		2,811,273.90	
Less—			
Collections	14,335.03		
Transfer vouchers issued to other projects	4,041.19		
		18,376.22	
Net investment			2,792,897.68
Total liabilities, reserves, and capital investments of the Government			2,875,752.71

Assets, liabilities, reserves, and capital, Uncompahgre project, to June 30, 1916.

ASSETS.

Inventory of stock on hand:		
Storehouse stock	$21,636.14	
Cement	2,543.07	
Lumber	4,403.90	
Explosives	53.11	
Forage in stock	524.69	
Fuel	378.34	
Freight and handling on inventory property	[1] 559.51	
		$28,979.74

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[1] Deduct.

Accounts receivable:			
Other uncollected items unclassified		$1,187.70	
Unadjusted transfers to other projects		670.86	
			$1,858.56
Construction work contracted:			
Unearned value of construction work contracted			768.30
Construction work in process:			
Gross cost of construction of project to date	$5,973,504.34		
Gross operation and maintenance cost during construction	505,547.09		
Plant accounts	4,588.60		
		6,483,640.03	
Less revenues earned during construction—			
Rentals of buildings	18,390.98		
Rentals of irrigation water	369,741.51		
Contractors' freight refunds	2,646.66		
Other revenues, unclassified	5.00		
Less cost adjustments—			
Profit on mess-house operations	7,575.31		
Profit on mercantile-store operations	20,419.44		
Profit on hospital operations	3,228.68		
Total deductions		422,007.58	
Net cost of construction of project to date			6,061,632.45
Total assets			6,093,239.05

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid progress earnings under construction contracts		$2,649.65	
Unpaid contract holdbacks		4,939.32	
Unpaid labor		12,317.90	
Unpaid purchases		744.97	
Unpaid freight and express charges		6,684.85	
Unpaid passenger fares		13.20	
Unpaid agreements to purchase real property		1,675.00	
Unredeemed coupon books		408.35	
Unredeemed meal tickets		53.75	
Other unpaid items unclassified (water rights)		9,213.68	
			38,700.67
Contingent obligations:			
Unearned value of construction work contracted			768.30
Capital investment:			
Disbursement vouchers	$6,424,435.66		
Appropriation transfer	18,173.74		
Transfer vouchers received from other projects	141,018.59		
		6,583,627.99	
Less—			
Collections	496,579.60		
Appropriation transfer	550.51		
Transfer vouchers issued to other projects	32,727.80		
		529,857.91	
Net investment			6,053,770.08
Total liabilities, reserves, and capital investments of the Government			6,093,239.05

Assets, liabilities, reserves, and capital, Boise project, to June 30, 1916.

ASSETS.

Cash:			
In other employees' hands, awaiting transfer to special fiscal agents		$12.90	
Cash in special deposit account		70.00	
			$82.90
Inventory of stock on hand:			
Storehouse stock		37,963.81	
Cement		8,779.77	
Structural iron and steel		3,543.10	
Lumber		10,486.38	
Explosives		1,373.88	
Forage in stock		761.20	
Fuel		825.77	
Goods in transit		7,095.72	
Products of local operations		934.14	
Freight and handling on inventory property		6,619.78	
			78,383.55
Accounts receivable:			
Uncollected rentals of irrigation water		19,585.65	
Other uncollected items unclassified		6,472.36	
Unadjusted transfers to other projects		296.00	
			26,354.01
Construction work contracted:			
Unearned value of construction work contracted			4,600.00
Construction work in process:			
Gross cost of construction of project to date	$11,260,261.67		
Gross operation and maintenance cost during construction	747,916.72		
Gross cost of producing commercial power during construction	27,540.14		
Plant accounts	90,972.37		
		12,126,690.90	
Less revenues earned during construction—			
Rentals of buildings	25,807.32		
Rentals of grazing and farming lands	12,532.61		
Rentals of power and light	50,312.46		
Rentals of irrigation water	378,721.99		
Contractors' freight refunds	13,082.53		
Forfeitures by defaulting bidders and contractors	24,197.92		
Other revenues, unclassified	27,242.38		
Less cost adjustments—			
Profit on mess-house operations	57,494.07		
Profit on mercantile-store operations	45,000.06		
Loss on hospital operations	[1] 6,248.26		
Total deductions		628,143.08	
Net cost of construction of project to date			11,498,547.82
Total assets			11,607,968.28

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:		
Unpaid labor	$25,705.62	
Unpaid purchases	29,535.30	
Unpaid feight and express charges	20,315.09	
Unpaid passenger fares	76.50	

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[1] Deduct.

Accounts payable—Continued.			
Unpaid agreements to purchase real property		$10,357.33	
Unredeemed coupon books		190.47	
Unredeemed meal tickets		68.76	
Guaranty and special deposits		115.48	
Other unpaid items unclassified		158.84	
			$86,523.39
Contingent obligations:			
Unearned value of construction work contracted			4,600.00
Capital investment:			
Disbursement vouchers	$11,944,138.32		
Transfer vouchers received from other projects	432,406.06		
		12,376,544.38	
Less—			
Collection vouchers, repayment refunds	737,024.74		
Transfer vouchers issued to other projects	122,674.75		
		859,699.49	
Net investment			11,516,844.89
Total liabilities, reserves, and capital investments of the Government			11,607,968.28

Assets, liabilities, reserves, and capital, Minidoka project, to June 30, 1916.

ASSETS.

Cash:			
In other employees' hands, awaiting transfer to special fiscal agents			$0.22
Inventory of stock on hand:			
Storehouse stock		$37,152.85	
Cement		225.58	
Structural iron and steel		1,098.37	
Lumber		6,854.54	
Explosives		248.35	
Forage in stock		593.90	
Fuel		265.35	
Products of local operations		756.94	
Freight and handling on inventory property		[1] 2,401.08	
			44,794.80
Accounts receivable:			
Construction charges due and uncollected from water right applicants		9,211.31	
Construction charges unaccrued on contracts with water-right applicants		3,852,986.87	
Operation and maintenance charges due and uncollected from water-right applicants		17,691.55	
Uncollected rentals of power and light		2,052.52	
Uncollected rentals of irrigation water		75,392.00	
Other uncollected items unclassified		8,348.76	
Unadjusted transfers to other projects		3,777.01	
			3,969,460.02
Construction work in process:			
Gross cost of construction of project to date	$4,669,438.27		
Gross supplemental construction cost of project to date, drainage	712,474.76		
Gross operation and maintenance cost during construction	83,675.41		
Plant accounts	14,614.52		
		5,480,202.96	

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[1] Deduct

Construction work in process—Contd.			
Less revenues earned during construction—			
Rentals of buildings	$7,007.57		
Rentals of grazing and farming lands	904.45		
Rentals of irrigation water	53,271.20		
Contractors' freight refunds	552.39		
Forfeitures by defaulting bidders and contractors	90.00		
Receipts from sale of townsite lots, above cost	131,158.51		
Other revenues, unclassified	9,228.92		
Less cost adjustments—			
Profit on hospital operations	1,292.56		
Total deductions		$203,505.60	
Net cost of construction of project to date			$5,276,697.36
Deferred operation and maintenance charges			212,438.27
Total assets			9,503,390.67

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid progress earnings under construction contracts		$15,848.71	
Unpaid labor		13,208.00	
Unpaid purchases		5,410.23	
Unpaid freight and express charges		5,097.16	
Unpaid passenger fares		172.30	
Unredeemed meal tickets		479.04	
Other unpaid items unclassified		84.37	
			40,299.81
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		4,186,792.71	
Value of construction contracts with water-right applicants temporarily suspended		179,227.50	
Construction charges paid in advance by water-right applicants		53,395.04	
Construction charges paid and forfeited by water-right applicants		8,218.06	
Penalties paid on construction charges by water-right applicants		1,116.75	
			4,428,750.06
Capital investment:			
Appropriation transfer	$3,073.27		
Disbursement vouchers	6,104,975.13		
Joint construction vouchers received	32,003.51		
Transfer vouchers received from other projects	305,760.35		
		6,445,812.26	
Less—			
Collections	1,155,526.84		
Collection vouchers, repayment refunds	458.00		
Joint construction vouchers issued	32,003.51		
Transfer vouchers issued to other projects	223,483.11		
Net investment		1,411,471.46	
			5,034,340.80
Total liabilities, reserves, and capital investments of the Government			9,503,390.67

Operating expenses and revenues, Minidoka project, to June 30, 1916.

EXPENSES.

Storage works:		
Operation	$36,015.74	
Maintenance	3,688.92	
		$39,704.66
Pumping for irrigation:		
Operation	157,872.77	
Maintenance	76,378.97	
		234,251.74
Canal system:		
Operation	15,499.95	
Maintenance	65,730.23	
		81,230.18
Lateral system:		
Operation	151,166.84	
Maintenance	289,276.17	
		440,443.01
Drainage system:		
Operation	17,672.86	
Maintenance	32,014.77	
		49,687.63
Undistributed expenses:		
Operation	97,739.18	
Maintenance	91,671.45	
		189,410.63
		1,034,727.85

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	406,558.33
Operation and maintenance charges paid in advance by water-right applicants	580.57
Operation and maintenance charges paid and forfeited by water-right applicants	2,326.78
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	1,658.82
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	[1] 3,027.72
Rental of land and buildings during operating period	1,027.11
Rentals of power and light during operating period	86,466.36
Rentals or irrigation water	157,695.96
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	83,675.41
Other revenues, unclassified, earned during operating period	85,327.96
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	212,438.27
Total	1,034,727.85

Assets, liabilities, reserves, and capital, Jackson Lake enlargement, to June 30, 1916.

ASSETS.

Inventory of stock on hand:		
Storehouse stock	$50,015.60	
Lumber	[1] 199.07	
Explosives	355.28	
Forage in stock	596.65	
Fuel	[1] 64.88	
Goods in transit	992.35	
Products of local operations	5,685.83	
Freight and handling on inventory property	[1] 384.44	
		$56,997.32

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[1] Deduct.

Accounts receivable:			
Other uncollected items unclassified			$98,213.75
Construction work in process:			
Gross cost of construction of project to date	$711,274.38		
Plant accounts	5,558.36		
		$716,832.74	
Less revenues earned during construction—			
Rentals of buildings	804.80		
Forfeitures by defaulting bidders and contractors	689.65		
Less cost adjustments—			
Loss on mess house operations	[1] $11,358.60		
Profit on mercantile store operations	7,558.62		
Loss on hospital operations	[1] 2,162.66		
Total deductions		[1] 4,468.19	
Net cost of construction of project to date			721,300.93
Total assets			876,512.00

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid contract holdbacks		$100.00	
Unpaid labor		7,759.02	
Unpaid purchases		3,356.69	
Unpaid freight and express charges		1,390.87	
Unpaid passenger fares		1,243.00	
Unredeemed coupon books		186.00	
Unredeemed meal tickets		5.05	
Other unpaid items unclassified		.82	
			14,041.45
Reserves for repayment to reclamation fund of cost of project:			
Charges accrued on Jackson Lake enlargement work			827,615.62
Capital investment:			
Disbursement vouchers	$688,655.47		
Transfer vouchers received from other projects	101,508.38		
		790,163.85	
Less—			
Collections	752,939.75		
Transfer vouchers issued to other projects	2,369.17		
Net investment		755,308.92	
			34,854.93
Total liabilities, reserves, and capital investments of the Government			876,512.00

Assets, liabilities, reserves, and capital, Garden City project, to June 30, 1916.

ASSETS.

Inventory of stock on hand—storehouse stock		$4,518.01
Construction work in process:		
Gross cost of construction of project to date	$385,465.35	

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[1] Deduct.

Construction work in process—Contd.			
Less revenues earned during construction—			
Rentals of buildings	$859.58		
Contractors' freight refunds	1,911.73		
Forfeitures by defaulting bidders and contractors	5,800.00		
Other revenues, unclassified	13.00		
Less cost adjustments—			
Profit on mess-house operations	860.82		
Profit on hospital operations	585.58		
Total deductions		$10,030.71	
Net cost of construction of project to date			$375,434.64
Total assets			379,952.65

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable—unpaid contract holdbacks			3,711.86
Capital investment:			
Disbursement vouchers	$380,066.31		
Transfer vouchers received from other projects	11,844.58		
		$391,910.89	
Less—			
Collections	4,807.67		
Transfer vouchers issued to other projects	10,862.43		
		15,670.10	
Net investment			376,240.97
Total liabilities, reserves, and capital investments of the Government			379,952.65

Assets, liabilities, reserves, and capital, Huntley project, to June 30, 1916.

ASSETS.

Inventory of stock on hand:		
Stores issued and not used	$9,295.68	
Storehouse stock	2,203.30	
Cement	366.20	
Structural iron and steel	3,194.66	
Lumber	144.58	
Explosives	1,072.36	
Forage in stock	753.54	
Products of local operations	750.50	
Freight and handling on inventory property	[1] 51.30	
		$17,729.52
Accounts receivable:		
Construction charges due and uncollected from water-right applicants	5,324.79	
Construction charges unaccrued on contracts with water-right applicants	591,445.15	
Operation and maintenance charges due and uncollected from water-right applicants	7,678.83	
Uncollected rentals of irrigation water	62.84	
Other uncollected items, unclassified	585.02	
		605,096.63

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[1] Deduct.

Construction work in process:			
Gross cost of construction of project to date	$997,017.61		
Gross supplemental construction cost of project to date	475,844.83		
Gross cost of producing commercial power during construction	19,330.78		
		$1,492,193.22	
Less revenues earned during construction—			
Rentals of buildings	315.00		
Rentals of grazing and farming lands	1,100.69		
Rentals of telephones and tolls	406.79		
Contractor's freight refunds	7,633.45		
Receipts from sale of town-site lots	37,544.72		
Other revenues, unclassified	212.00		
Less cost adjustments, loss on hospital operations	2,825.65		
Total deductions		50,038.30	
Net cost of construction of project to date			$1,442,154.92
Deferred operations and maintenance charges			92,248.61
Total assets			2,157,229.68

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid progress earnings under construction contracts		$1,500.00	
Unpaid labor		9,746.66	
Unpaid purchases		2,743.66	
Unpaid freight and express charges		3,923.93	
Unpaid passenger fares		26.71	
Guarantee and special deposits		105.68	
			18,046.64
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		802,887.90	
Value of construction contracts with water-right applicants temporarily suspended		58,276.86	
Construction charges paid in advance by water-right applicants		1,438.69	
Construction charges paid and forfeited by water-right applicants		3,779.55	
Penalties paid on construction charges by water-right applicants		234.32	
			866,617.32
Capital investment:			
Disbursement vouchers	$1,808,536.08		
Transfer vouchers received from other projects	87,247.28		
		1,895,783.36	
Less—			
Collections	462,099.67		
Collection vouchers, repayment refunds	631.52		
Transfer vouchers issued to other projects	160,486.45		
Net investment		623,217.64	
			1,272,565.72
Total liabilities, reserves, and capital investments of the Government			2,157,229.68

Operating expenses and revenues Huntley project, to June 30, 1916.

EXPENSES.

Pumping for irrigation:		
Operation	$3,030.23	
Maintenance	7,712.11	
		$10,742.34
Canal system:		
Operation	13,273.99	
Maintenance	33,537.97	
		46,811.96
Lateral system:		
Operation	24.105.38	
Maintenance	122,607.43	
		146,712.81
Drainage system:		
Maintenance		6,818.56
Undistributed expenses:		
Operation	2.625.39	
Maintenance	8,314.33	
		10,939.72
Total		222,025.39

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	122,465.60
Operation and maintenance charges paid in advance by water-right applicants	75.13
Operation and maintenance charges paid and forfeited by water-right applicants	949.79
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	422.45
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	[1] 544.45
Rental of land and buildings during operating period	4,131.30
Rentals of grazing and farming lands during operating period	23.75
Rentals of irrigation water	344.46
Rental of telephone and tolls during operating period	2.35
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	1,781.61
Other revenues unclassified, earned during operating period	124.79
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	92,248.61
Total	222,025.39

Assets, liabilities, reserves, and capital, Milk River project, to June 30, 1916.

ASSETS.

Cash:		
In special fiscal agent's possession, awaiting remittance	$70.00	
Cash in special deposit account	72.85	
		$142.85
Inventory of stock on hand:		
Storehouse stock	16,539.94	
Cement	5,357.45	
Products of local operations	97.63	
Freight and handling on inventory property	[1] 143.67	
		21,851.35
Accounts receivable:		
Uncollected rentals of grazing and farming lands	25.00	
Uncollected rentals of irrigation water	1,694.80	
Uncollected freight refunds	4,115.34	
Other uncollected items unclassified	99.46	
		5,934.60

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[1] Deduct.

Construction work contracted:			
Unearned value of construction work contracted		$88,231.82	
Estimated engineering expenses on construction work contracted		13,500.00	$101,731.82
Construction work in process:			
Gross cost of construction of project to date	$2,672,930.35		
Gross operation and maintenance cost during construction	51,015.21		
Plant accounts	17,754.38	2,741,699.94	
Less revenues earned during construction—			
Rentals of buildings	1,743.13		
Rentals of grazing and farming lands	1,769.00		
Rentals of irrigation water	11,834.17		
Contractors' freight refunds	18,582.71		
Forfeitures by defaulting bidders and contractors	1,865.26		
Receipts from sale of town-site lots	[1] 239.78		
Other revenues, unclassified	168.15		
Less cost adjustments—			
Profit on mess-house operations	3,901.52		
Profit on mercantile store operations	3,597.17		
Profit on hospital operations	470.01		
Total deductions		43,691.34	
Net cost of construction of project to date			2,698,008.60
Total assets			2,827,669.22
LIABILITIES, RESERVES, AND CAPITAL.			
Accounts payable:			
Unpaid progress earnings under construction contracts		22,826.01	
Unpaid contract holdbacks		6,242.90	
Unpaid labor		3,446.42	
Unpaid purchases		20,069.20	
Unpaid freight and express charges		8,145.81	
Unpaid passenger fares		36.55	
Unpaid agreements to purchase real property		468.80	
Unredeemed coupon books		29.10	
Guarantee and special deposits		72.85	
Other unpaid items, unclassified		320.21	61,657.85
Contingent obligations:			
Unearned value of construction work contracted		88,231.82	
Estimated engineering expenses on construction work contracted		13,500.00	101,731.82
Capital investment:			
Disbursement vouchers	$2,597,575.61		
Transfer vouchers received from other projects	139,993.34	2,737,568.95	
Less—			
Collections	37,640.63		
Transfer vouchers issued to other projects	35,648.77	73,289.40	
Net investment			2,664,279.55
Total liabilities, reserves, and capital investments of the Government			2,827,669.22

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[1] Deduct.

Assets, liabilities, reserves, and capital, St. Mary storage unit, to June 30, 1916.

ASSETS.

Cash:			
In special fiscal agent's possession, awaiting remittance			$51.85
Inventory of stock on hand:			
Stores issued and not used		$7,720.18	
Storehouse stock		29,712.45	
Cement		18,414.21	
Structural iron and steel		6,527.01	
Lumber		1,327.56	
Explosives		365.09	
Forage in stock		10,364.87	
Fuel		427.95	
Goods in transit		294.46	
Freight and handling on inventory property		[1] 1,298.72	
			73,855.06
Accounts receivable:			
Uncollected freight refunds		$2,643.33	
Other uncollected items unclassified		137.83	
Unadjusted transfers to other projects		40.63	
			$2,821.79
Construction work in process:			
Gross cost of construction of project to date	$1,975,315.29		
Gross operation and maintenance cost during construction	15,960.32		
Plant accounts	96,573.94		
		2,087,849.55	
Less revenues earned during construction—			
Rentals of buildings	14,774.93		
Rentals of telephones and tolls	684.95		
Contractors' freight refunds	6,499.10		
Forfeitures by defaulting bidders and contractors	1,893.22		
Other revenues, unclassified	8.50		
Less cost adjustments—			
Loss on mess-house operations	[1] 3,802.38		
Profit on mercantile store operations	4,694.34		
Profit on hospital operations	2,270.14		
Total deductions		27,022.80	
Net cost of construction of project to date			2,060,826.75
Total assets			2,137,555.45

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor		$7,374.43	
Unpaid purchases		12,632.23	
Unpaid freight and express charges		5,626.54	
Unpaid passenger fares		29.24	
Unredeemed coupon books		296.30	
Other unpaid items unclassified		9,502.89	
			35,461.63
Capital investment:			
Disbursement vouchers	$1,996,935.89		
Transfer vouchers received from other projects	211,335.78		
		2,208,271.67	

---

[1] Deduct.

Capital investments—Continued.			
Less—			
Collection vouchers, repayment refunds	$51,113.26		
Transfer vouchers issued to other projects	55,064.59		
		$106,177.85	
Net investment			$2,102,093.82
Total liabilities, reserves, and capital investments of the Government			2,137,555.45

Assets, liabilities, reserves, and capital, Sun River project, to June 30, 1916.

ASSETS.

Inventory of stock on hand:			
Stores issued and not used		$695.74	
Storehouse stock		51,328.10	
Cement		6,801.97	
Lumber		6,238.25	
Explosives		111.30	
Fuel		73.78	
Products of local operations		1,112.67	
Freight and handling on inventory property		[1] 1,083.79	
			$65,278.02
Accounts receivable:			
Construction charges due and uncollected from water right applicants		2,813.25	
Construction charges unaccrued on contracts with water-right applicants		256,785.40	
Operation and maintenance charges due and uncollected from water-right applicants		2,101.77	
Uncollected rentals of buildings		45.00	
Uncollected freight refunds		6,993.07	
Uncollected rentals of grazing and farming land		283.20	
Other uncollected items unclassified		333.93	
			269,355.26
Construction work contracted:			
Unearned value of construction work contracted		118,066.32	
Estimated engineering expenses on construction work contracted		10,600.00	
			128,666.32
Construction work in process:			
Gross cost of construction of project to date	$3,052,135.97		
Plant accounts	42,475.48		
		3,094,611.45	
Less revenues earned during construction—			
Rentals of buildings	11,234.57		
Rentals of grazing and farming lands	7,590.71		
Rentals of telephones and tolls	301.65		
Contractors' freight refunds	10,027.97		
Receipts from sale of townsite lots	8,268.19		
Other revenues, unclassified	21,282.05		
Less cost adjustments—			
Loss on mess-house operations	[1] 4,716.47		
Profit on mercantile store operations	2,885.11		
Loss on hospital operations	[1] 771.85		
Total deductions		73,078.57	
Net cost of construction of project to date			3,021,532.88
Deferred operation and maintenance charges			41,232.42
Total assets			3,526,065.26

---

[1] Deduct.

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid progress earnings under construction contracts		$17,192.44	
Unpaid contract holdbacks		12,870.98	
Unpaid labor		10,395.50	
Unpaid purchases		11,926.62	
Unpaid freight and express charges		9,539.81	
Unpaid passenger fares		114.85	
Unredeemed coupon books		71.17	
Other unpaid items unclassified		2,060.84	
			$64,172.21
Contingent obligations:			
Unearned value of construction work contracted		118,066.32	
Estimated engineering expenses on construction work contracted		10,600.00	
			128,666.32
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		313,579.83	
Value of construction contracts with water-right applicants temporarily suspended		43,664.16	
Construction charges paid in advance by water-right applicants		1,203.79	
Construction charges paid and forfeited by water-right applicants		3,197.88	
Penalties paid on construction charges by water-right applicants		125.60	
			361,771.26
Capital investment:			
Disbursement vouchers	$3,086,168.34		
Transfer vouchers received from other projects	163,135.54		
		3,249,303.88	
Less—			
Collections	207,895.26		
Collection vouchers, repayment refunds	881.82		
Joint construction vouchers issued	69.071.33		
		277,848.41	
Net investment			2,971,455.47
Total liabilities, reserves, and capital investment of the Government			3,526,065.26

Operating expenses and revenues, Sun River project, to June 30, 1916.

EXPENSES.

Storage works:		
Operation	$1,047.55	
Maintenance	1,255.96	
		$2,303.51
Canal system:		
Operation	5,400.48	
Maintenance	17,807.25	
		23,207.73
Lateral system:		
Operation	13,553.56	
Maintenance	39,585.39	
		53,138.95
Undistributed expenses:		
Operation	7,711.86	
Maintenance	2,630.11	
		10,341.97
Total		88,992.16

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	$43,719.68
Operation and maintenance charges paid in advance by water-right applicants	305.32
Operation and maintenance charges paid and forfeited by water-right applicants	635.66
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	.77
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	[1] 277.42
Rentals of irrigation water	497.79
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	2,810.71
Other revenues unclassified, earned during operating period	67.23
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves and capital statement)	41,232.42
Total	88.992.16

Assets, liabilities, reserves, and capital, Lower Yellowstone project, to June 30, 1916.

ASSETS.

Inventory of stock on hand:			
Stores issued and not used		$2,115.30	
Storehouse stock		96.59	
Cement		879.90	
Products of local operations		97.44	
Freight and handling on inventory property		165.35	
			$3,354.58
Accounts receivable:			
Construction charges due and uncollected from water-right applicants		57,791.28	
Construction charges unaccrued on contracts with water-right applicants		1,150,526.77	
Operation and maintenance charges due and uncollected from water-right applicants		102,718.51	
Uncollected rentals of buildings		12.00	
Uncollected rentals of grazing and farming lands		70.00	
Uncollected rentals of irrigation water		5,340.22	
Other uncollected items unclassified		11.00	
Unadjusted transfers to other projects		104.03	
			1,316,573.81
Construction work in process:			
Gross cost of construction of project to date	$2,830,388.75		
Gross supplemental construction cost of project to date	62,829.73		
		2,893,218.48	
Less revenues earned during construction—			
Rentals of buildings	422.00		
Rentals of irrigation water	27,176.94		
Rentals of telephones and tolls	4,331.04		
Contractors' freight refunds	21,261.33		
Less cost adjustments, loss on mess-house operations	[1] 4,422.69		
Total deductions		48,768.62	
Net cost of construction of project to date			2,844,449.86
Deferred operation and maintenance charges			325,325.46
Total assets			4,489,703.71

---

[1] Deduct.

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid contract holdbacks		$13, 832. 11	
Unpaid labor		2, 178. 03	
Unpaid purchases		144. 70	
Unpaid freight and express charges		302. 17	
Unpaid passenger fares		138. 45	
Unpaid agreements to purchase real property		694. 00	
Other unpaid items unclassified		11, 927. 68	
			$29, 217. 14
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		1, 043, 918. 35	
Value of construction contracts with water-right applicants temporarily suspended		174, 378. 95	
Construction charges paid in advance by water-right applicants		25, 327. 52	
Construction charges paid and forfeited by water-right applicants		595. 00	
Penalties paid on construction charges by water-right applicants		14. 88	
			1, 244, 234. 70
Capital investment:			
Disbursement vouchers	$3, 294, 422. 82		
Joint construction vouchers received	103, 278. 21		
		3, 397, 701. 03	
Less—			
Collections	140, 139. 28		
Joint construction vouchers issued	41, 309. 88		
		181, 449. 16	
Net investment			3, 216, 251. 87
Total liabilities, reserves, and capital investments of the Government			4, 489, 703. 71

Operating expenses and revenues, Lower Yellowstone project, to June 30, 1916.

EXPENSES.

Storage works:		
Mainteance		$93, 337. 98
Canal system:		
Operation	$28, 465. 18	
Maintenance	137, 436. 84	
		165, 902. 02
Lateral system		124, 777. 60
Flood-protection system:		
Maintenance		34. 33
Undistributed expenses:		
Operation	9, 100. 56	
Maintenance	79, 011. 65	
		88, 112. 21
Total		472, 164. 14

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	138, 453. 74
Operation and maintenance charges paid in advance by water-right applicants	622. 96
Operation and maintenance charges paid and forfeited by water-right applicants	440. 00

Penalties on operation and maintenance charges accrued on contracts with water-right applicants	$0.04
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	[1] 4.22
Rental of land and buildings during operating period	5,464.76
Rentals of grazing and farming lands during operating period	579.00
Rentals of irrigation water	48.50
Rental of telephone and tolls during operating period	499.97
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	1,700.05
Other revenues unclassified, earned during operating period	[1] 966.12
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	325,325.46
Total	472,164.14

Assets, liabilities, reserves, and capital, North Platte project, to June 30, 1916.

ASSETS.

Cash:			
Cash in special deposit account			$5,299.94
Inventory of stock on hand:			
Storehouse stock		$21,936.54	
Cement		3,308.64	
Structural iron and steel		8,914.45	
Lumber		4,575.25	
Explosives		109.44	
Forage in stock		5,794.79	
Fuel		1,616.33	
Products of local operations		7,075.04	
			53,330.48
Accounts receivable:			
Construction charges due and uncollected from water-right applicants		67,536.97	
Construction charges unaccrued on contracts with water-right applicants		5,327,075.05	
Operation and maintenance charges due and uncollected from water-right applicants		24,700.94	
Uncollected rentals of irrigation water		392.00	
			5,419,704.96
Construction work contracted:			
Unearned value of construction work contracted		280,200.52	
Estimated engineering expenses on construction work contracted		28,000.00	
			308,200.52
Construction work in process:			
Gross cost of construction of project to date	$6,683,749.66		
Gross operation and maintenance cost during construction	509,805.43		
Plant accounts	62,210.77		
		7,255,765.86	
Less revenues earned during construction—			
Rentals of buildings	5,385.68		
Rentals of grazing and farming lands	8,314.44		
Rentals of irrigation water	19,328.30		
Contractors' freight refunds	15,551.80		
Forfeitures by defaulting bidders and contractors	16,305.00		
Other revenues, unclassified	1,902.79		

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[1] Deduct.

Construction work in process—Continued.			
Less cost adjustments—			
Loss on mess-house operations	[1]$13,417.69		
Profit on mercantile-store operations	4,806.93		
Profit on hospital operations	6,366.83		
Total deductions		$64,544.08	
Net cost of construction of project to date			$7,191,221.78
Deferred operation and maintenance charges			57,070.04
Total assets			13,034,827.72

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid progress earnings under construction contracts		$58,318.10	
Unpaid contract holdbacks		27,503.43	
Unpaid labor		14,883.73	
Unpaid purchases		6,986.49	
Unpaid freight and express charges		12,082.81	
Unpaid passenger fares		127.89	
Unredeemed coupon books		26.50	
Unredeemed meal tickets		5.75	
Guaranty and special deposits		5,299.94	
Other unpaid items unclassified		22.94	
			125,257.58
Contingent obligations:			
Unearned value of construction work contracted		280,200.52	
Estimated engineering expenses on construction work contracted		28,000.00	
			308,200.52
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		5,646,012.05	
Value of construction contracts with water-right applicants temporarily suspended		98,330.00	
Construction charges paid in advance by water-right applicants		81.75	
Construction charges paid and forfeited by water-right applicants		5,181.65	
Penalties paid on construction charges by water-right applicants		6,571.62	
			5,756,177.07
Capital investment:			
Disbursement vouchers	$7,451,859.57		
Transfer vouchers received from other projects	214,962.00		
		7,666,821.57	
Less—			
Collections	793,476.97		
Collection vouchers, repayment refunds	441.12		
Transfer vouchers issued to other projects	27,710.93		
		821,629.02	
Net investment			6,845,192.55
Total liabilities, reserves, and capital investments of the Government			13,034,827.72

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[1] Deduct.

Operating expenses and revenues North Platte (Interstate) project, to June 30, 1916.

EXPENSES.

Storage works:		
Operation	$22,677.99	
Maintenance	5,804.28	
		$28,482.27
Canal system:		
Operation	80,595.84	
Maintenance	136,595.44	
		217,191.28
Lateral system:		
Operation	142,030.78	
Maintenance	116,322.00	
		258,352.78
Drainage system:		
Operation	446.40	
Maintenance	4,982.38	
		5,428.78
Total		509,455.11

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	366,142.53
Operation and maintenance charges paid in advance by water-right applicants	20.62
Operation and maintenance charges paid and forfeited by water-right applicants	1,031.95
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	650.71
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	1,970.20
Rentals of irrigation water	5,161.21
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	81,348.25
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	57,070.04
Total	509,455.11

Assets, liabilities, reserves, and capital, Truckee-Carson project, to June 30, 1916.

ASSETS.

Cash:		
Cash in special deposit account		$11,934.63
Inventory of stock on hand:		
Storehouse stock	$53,028.79	
Cement	457.38	
Structural iron and steel	932.05	
Lumber	2,647.67	
Explosives	62.90	
Forage in stock	354.30	
Goods in transit	6.00	
Freight and handling on inventory property	[1] 2,965.21	
		54,523.88
Accounts receivable:		
Construction charges due and uncollected from water-right applicants	4,762.38	
Construction charges unaccrued on contracts with water-right applicants	651,209.35	
Operation and maintenance charges due and uncollected from water-right applicants	16,985.93	
Uncollected rentals of grazing and farming lands	1,752.83	
Uncollected rentals of power and light	1,730.25	
Uncollected rentals of irrigation water	42.50	
Other uncollected items unclassified	230.63	
		676,713.87

Construction work in process:			
Gross cost of construction of project to date	$5,948,867.72		
Plant accounts	24,449.20	$5,973,316.92	
Less revenues earned during construction—			
Rentals of buildings	17,684.11		
Rentals of grazing and farming lands	17,919.82		
Contractors' freight refunds	412.07		
Forfeitures by defaulting bidders and contractors	499.95		
Less cost adjustments—			
Profit on mess-house operations	17,756.13		
Profit on mercantile-store operations	17,825.35		
Loss on hospital operations	[1] 1,377.97		
Plant accounts	22,608.05		
Total deductions		93,327.51	
Net cost of construction of project to date			$5,877,966.48
Deferred operation and maintenance charges			140,270.84
Total assets			6,763,432.63

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid progress earnings under construction contracts		$6,680.85	
Unpaid labor		5,266.59	
Unpaid purchases		1,881.84	
Unpaid freight and express charges		4,434.55	
Unpaid passenger fares		61.55	
Unpaid agreements to purchase real property		1,504.00	
Unredeemed coupon books		119.85	
Unredeemed meal tickets		144.00	
Guaranty and special deposits		11,934.63	
Other unpaid items unclassified		27.00	32,054.86
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		937,519.13	
Value of construction contracts with water-right applicants temporarily suspended		9,576.00	
Construction charges paid in advance by water-right applicants		9,425.76	
Construction charges paid and forfeited by water-right applicants		1,444.60	
Penalties paid on construction charges by water-right applicants		280.21	958,245.70
Capital investment:			
Disbursement vouchers	$6,165,013.01		
Joint construction vouchers received	11,594.86		
Transfer vouchers received from other projects	285,621.81	6,462,229.68	

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[1] Deduct.

Capital investment—Continued.			
Less—			
Collections	$627,202.79		
Collection vouchers, repayment refunds	252.00		
Joint construction vouchers issued	11,594.86		
Transfer vouchers issued to other projects	50,047.96		
		$689,097.61	
Net investment			$5,773,132.07
Total liabilities, reserves, and capital investments of the Government			6,763,432.63

Operating expenses and revenues Truckee-Carson project, to June 30, 1916.

EXPENSES.

Storage works:		
Operation	$27,437.83	
Maintenance	13,035.36	
		$40,473.19
Canal system:		
Operation	6,251.87	
Maintenance	17,178.26	
		23,430.13
Lateral system:		
Operation	126,166.90	
Maintenance	163,432.09	
		289,598.99
Drainage system:		
Operation	1,218.56	
Maintenance	43,330.73	
		44,549.29
Flood protection system:		
Maintenance		1,441.16
Undistributed expenses		16,531.97
Total		416,024.73

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	214,687.53
Operation and maintenance charges paid in advance by water-right applicants	28.63
Operation and maintenance charges paid and forfeited by water-right applicants	1,240.87
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	945.15
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	[1] 916.69
Rental of land and buildings during operating period	542.27
Rentals of power and light during operating period	27,445.95
Rentals of irrigation water	5,553.30
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	2,022.93
Other revenues unclassified, earned during operating period	24,203.95
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	140,270.84
Total	416,024.73

---

[1] Deduct.

Assets, liabilities, reserves, and capital, Carlsbad project, to June 30, 1916.

ASSETS.

Inventory of stock on hand:			
Storehouse stock		$5,793.48	
Cement		517.44	
Lumber		2,274.26	
Explosives		1,052.57	
Forage in stock		27.91	
Fuel		147.30	
Goods in transit		7,761.46	
			$17,574.42
Accounts receivable:			
Construction charges due and uncollected from water-right applicants		14,679.98	
Construction charges unaccrued on contracts with water-right applicants		894,278.20	
Operation and maintenance charges due and uncollected from water-right applicants		13,314.26	
Other uncollected items unclassified		161.70	
			922,434.14
Construction work in process:			
Gross cost of construction of project to date	$1,065,201.85		
Plant accounts	15,904.51		
		1,081,106.36	
Less revenues earned during construction—			
Rentals of buildings	578.00		
Rentals of irrigation water	8,163.35		
Other revenues, unclassified	2,357.88		
Less cost adjustments on hospital operations	[1] 150.51		
Total deductions		10,948.72	
Net cost of construction of project to date			1,070,157.64
Deferred operation and maintenance charges			10,097.39
Total assets			2,020,263.59

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:		
Unpaid labor	$3,309.93	
Unpaid purchases	1,593.67	
Unpaid freight and express charges	2,464.08	
Unpaid passenger fares	82.45	
Other unpaid items unclassified	7,004.40	
		14,454.53
Reserves for repayment to reclamation fund of cost of project:		
Value of construction contracts with water-right applicants	1,037,295.00	
Value of construction contracts with water-right applicants temporarily suspended	10,485.00	
Construction charges paid in advance by water-right applicants	1,379.38	
Construction charges paid and forfeited by water-right applicants	151.90	
Penalties paid on construction charges by water-right applicants	1,080.64	
		1,050,391.92

---

[1] Deduct.

Capital investment:			
Disbursement vouchers	$1,231,671.73		
Appropriation transfers	9,807.81		
Transfer vouchers received from other projects	34,084.53		
		$1,275,564.07	
Less—			
Collections	306,435.97		
Transfer vouchers issued to other projects	13,710.96		
		320,146.93	
			$955,417.14
Total liabilities, reserves, and capital investments of the Government			2,020,263.59

Operating expenses and revenues, Carlsbad project, to June 30, 1916.

EXPENSES.

Storage works:		
Maintenance		$8,651.39
Canal system:		
Operation	$70,875.25	
Maintenance	39,991.42	
		110,866.67
Lateral system:		
Maintenance		43,559.16
Drainage system:		
Maintenance		1,218.12
Undistributed expenses:		
Operation	5,228.29	
Maintenance	5,103.25	
		10,331.54
Total		174,626.88

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	152 788.91
Operation and maintenance charges paid in advance by water-right applicants	570.68
Operation and maintenance charges paid and forfeited by water-right applicants	110.85
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	698.25
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	[1] 323.89
Rental of land and buildings during operating period	3,105.44
Rentals of grazing and farming lands during operating period	256.00
Rentals of irrigation water	5,159.28
Other revenues unclassified earned during operating period	2,163.97
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	10,097.39
Total	174,626.88

Assets, liabilities, reserves, and capital, Hondo project, to June 20, 1916.

ASSETS.

Inventory of stock on hand:		
Storehouse stock	$27.05	
Lumber	63.51	
Forage in stock	17.10	
		$107.66

---

[1] Deduct.

Accounts receivable:			
Uncollected rentals of irrigation water			$3.70
Construction work in process:			
Gross cost of construction of project to date	$339,491.68		
Gross operation and maintenance cost during construction	38,914.59		
Plant accounts	270.00		
		$378,676.27	
Less revenues during construction—			
Rentals of buildings	220.00		
Rentals of irrigation water	8,229.40		
Contractor's freight refunds	159.63		
Other revenues, unclassified	55.36		
Loss on hospital operations	[1] 78.00		
Total deductions		8,586.39	
Net cost of construction of project to date			370,089.88
Total assets			370,201.24

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor		$248.33	
Unpaid purchases		61.10	
Unpaid freight and express charges		1.55	
			310.98
Capital investment:			
Disbursement vouchers	$390,328.61		
Appropriation transfers	441.61		
Transfer vouchers received from other projects	13,834.97		
		404,605.19	
Less—			
Collections	33,838.16		
Transfer vouchers issued to other projects	876.77		
Net investment		34,714.93	
			369,890.26
Total liabilities, reserves, and capital investments of the Government			370,201.24

Assets, liabilities, reserves, and capital, Rio Grande project (exclusive of Elephant Butte storage), to June 30, 1916.

ASSETS.

Inventory of stock on hand:		
Stores issued and not used	$1,293.78	
Storehouse stock	12,694.15	
Cement	790.46	
Structural iron and steel	1,885.43	
Lumber	4,559.66	
Explosives	18.45	
Forage in stock	14.79	
Fuel	495.81	
Freight and handling on inventory property	1,399.39	
		$23,151.92
Accounts receivable:		
Uncollected rentals of irrigation water	47,549.72	
Other uncollected items unclassified	179.09	
		47,728.81

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[1] Deduct.

Construction work in process:			
Gross cost of construction of project to date	$1,626,089.44		
Gross operation and maintenance cost during construction	151,133.53		
Plant accounts	38,704.08		
		$1,815,927.05	
Less revenues earned during construction—			
Rentals of buildings	828.74		
Rentals of irrigation water	212,453.25		
Contractors' freight refunds	2,156.77		
Less cost adjustments—			
Loss on mess house operations	[1]3,063.11		
Profit on mercantile store operations	666.03		
Profit on hospital operations	7,926.43		
Total deductions		220,968.11	
Net cost of construction of project to date			$1,594,958.94
Total assets			1,665,839.67

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor	$10,060.94		
Unpaid purchases	4,072.29		
Unpaid freight and express charges	8,072.09		
Unpaid passenger fares	170.35		
Unpaid agreements to purchase real property	17,817.45		
Unredeemed coupon books	94.25		
		$40,287.37	
Capital investment:			
Disbursement vouchers	1,739,464.59		
Transfer vouchers received from other projects	95,319.66		
		1,834,784.25	
Less—			
Collections	171,996.43		
Transfer vouchers issued to other projects	37,235.52		
		209,231.95	
Net investment			1,625,552.30
Total liabilities, reserves, and capital investments of the Government			1,665,839.67

Assets, liabilities, reserves, and capital, Elephant Butte storage project, to June 30, 1916.

ASSETS.

Cash:		
In special fiscal agent's possession, awaiting remittance		$1,058.35
Inventory of stock on hand:		
Stores issued and not used	$1,726.08	
Storehouse stock	38,632.56	
Cement	587.26	
Lumber	2,988.68	
Explosives	6,109.05	
Forage in stock	273.87	
Fuel	64.37	
Freight and handling on inventory property	[1]6,631.82	
		43,750.05

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[1] Deduct.

Accounts receivable:			
Uncollected items unclassified		$9,793.88	
Unadjusted transfers to other projects		831.49	
			$10,625.37
Construction work in process:			
Gross cost of construction of project to date		4,931,864.46	
Less revenues earned during construction—			
Rentals of buildings	$32,332.17		
Rentals of power and light	2,243.33		
Contractors' freight refunds	2,213.66		
Forfeitures by defaulting bidders and contractors	5,313.43		
Other revenues, unclassified	584.34		
Less cost of adjustments—			
Loss on mess house operations	[1] 233.07		
Profit on mercantile store operations	86,413.19		
Loss on hospital operations	[1] 8,377.91		
Profit on railroad operations	19,997.07		
Total deductions		75,821.87	
Net cost of construction of project to date			4,856,042.59
Total assets			4,911,476.36

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor		$9,566.93	
Unpaid purchases		2,561.48	
Unpaid freight and express charges		16,116.28	
Unpaid passenger fares		43.35	
Unpaid agreements to purchase real property		3,200.00	
Unredeemed coupon books		531.90	
Other unpaid items, unclassified		80.00	
			32,099.94
Capital investment:			
Disbursement vouchers	$4,969,927.34		
Transfer vouchers received from other projects	231,945.21		
		5,201,872.55	
Less—			
Collections	249,005.19		
Transfer vouchers issued to other projects	73,490.94		
		322,496.13	
Net investment			4,879,376.42
Total liabilities, reserves, and capital investments of the Government			4,911,476.36

Assets, liabilities, reserves, and capital, North Dakota pumping project, to June 30, 1916.

ASSETS.

Inventory of stock on hand:		
Stores issued and not used	$399.59	
Storehouse stock	3,229.34	
Structural iron and steel	364.25	
Forage in stock	287.94	
Fuel	677.32	
Products of local operations	53.32	
Freight and handling on inventory property	[1] 33.59	
		$4,978.17

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[1] Deduct.

Accounts receivable:			
Construction charges due and uncollected from water-right applicants		$39,909.37	
Construction charges unaccrued on contracts with water-right applicants		231,548.94	
Operation and maintenance charges due and uncollected from water-right applicants		11,314.63	
Uncollected rentals of power and light		2,175.00	
Uncollected rentals of irrigation water		821.57	
			$285,769.51
Construction work in process:			
Gross cost of construction of project to date		739,880.25	
Less revenues earned during construction—			
Rentals of buildings	$347.16		
Rentals of irrigation water	196.75		
Contractors' freight refunds	5,495.08		
Total deductions		6,038.99	
Net cost of construction of project to date			733,841.26
Deferred operation and maintenance charges			204,074.93
Total assets			1,228,663.87

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor		$1,498.85	
Unpaid purchases		107.74	
Unpaid freight and express charges		111.92	
Unpaid passenger fares		2.40	
Other unpaid items, unclassified		78.15	
			1,799.06
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		279,090.18	
Construction charges paid in advance by water-right applicants		16.43	
Construction charges paid and forfeited by water-right applicants		202.40	
Penalties paid on construction charges by water-right applicants		15.72	
			279,324.73
Capital investment:			
Disbursement vouchers	$1,041,622.48		
Transfer vouchers received from other projects	195,853.85		
		1,237,476.33	
Less—			
Collections	106,595.71		
Collection vouchers, repayment refunds	153.00		
Transfer vouchers issued to other projects	183,187.54		
		289,936.25	
Net investment			947,540.08
Total liabilities, reserves, and capital investments of the Government			1,228,663.87

Operating expenses and revenues North Dakota pumping project to June 30, 1916.

EXPENSES.

Pumping for irrigation:		
Operation	$182,934.57	
Maintenance	45,444.74	
		$228,379.31
Canal system:		
Operation	100.99	
Maintenance	2,179.57	
		2,280.56
Lateral system:		
Operation	24,930.14	
Maintenance	10,055.44	
		34,985.58
Commercial power operations		82,224.87
Total		347,870.32

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	24,340.51
Operation and maintenance charges paid in advance by water-right applicants	101.20
Operation and maintenance charges paid and forfeited by water-right applicants	156.27
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	44.09
Rental of land and buildings during operating period	1,999.83
Rentals of power and light during operating period	75,320.95
Rentals of irrigation water	2,768.35
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	22,191.93
Other revenues unclassified, earned during operating period	16,872.26
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	204,074.93
Total	347,870.32

Assets, liabilities, reserves, and capital, Lawton project, to June 30, 1916.

ASSETS.

Construction work in process:			
Gross cost of construction of project to date	$9,646.64		
Plant accounts	894.77		
		$10,541.41	
Less cost adjustments, profit on hospital operations		9.00	
Net cost of construction of project to date			$10,532.41
Total assets			10,532.41

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid purchases		$615.13	
Unpaid freight and express charges		5.66	
Unpaid passenger fares		22.22	
			643.01
Capital investment:			
Disbursement vouchers	$8,575.57		
Vouchers received (approximate)	230.35		
Transfer vouchers received from other projects	1,407.18		
		10,213.10	

Capital investment—Continued.			
Less—			
Collections	$0.20		
Transfer vouchers issued	323.50		
		$323.70	
Net investment			$9,889.40
Total liabilities, reserves, and capital investments of the Government			10,532.41

Assets, liabilities, reserves, and capital, Umatilla project, to June 30, 1916.

ASSETS.

Inventory of stock on hand:			
Storehouse stock		$7,001.67	
Cement		9,187.42	
Lumber		894.89	
Forage in stock		1,634.50	
Fuel		80.58	
Products of local operations		2,647.53	
			$21,446.59
Accounts receivable:			
Construction charges due and uncollected from water-right applicants		19,282.98	
Construction charges unaccrued on contracts with water-right applicants		680,156.54	
Operation and maintenance charges due and uncollected from water-right applicants		15,690.08	
Uncollected rentals of irrigation water		3.49	
Other uncollected items unclassified		4.80	
			715,137.89
Construction work in process:			
Gross cost of construction of project to date	$2,153,657.22		
Gross supplemental construction cost of project to date	14,118.95		
Plant accounts	7,816.07		
		2,175,592.24	
Less revenues earned during construction—			
Rentals of buildings	4,599.25		
Rentals of grazing and farming lands	21,891.46		
Rentals of irrigation water	95.54		
Contractors' freight refunds	1,055.31		
Forfeitures by defaulting bidders and contractors	100.00		
Other revenues, unclassified	10,060.00		
Less cost adjustments—			
Profit on mess house operations	2,687.78		
Profit on mercantile store operations	7.75		
Loss on hospital operations	[1] 1,061.19		
		39,435.90	
Net cost of construction of project to date			2,136,156.34
Deferred operation and maintenance charges			115,661.61
Total assets			2,988,402.43

Deduct.

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor		$11,037.91	
Unpaid purchases		6,825.26	
Unpaid freight and express charges		11,282.36	
Unpaid passenger fares		70.20	
			$29,215.73
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		753,898.93	
Value of construction contracts with water-right applicants temporarily suspended		120,865.00	
Construction charges paid in advance by water-right applicants		27,265.11	
Construction charges paid and forfeited by water-right applicants		3,668.72	
Penalties paid on construction charges by water-right applicants		437.64	
			906,135.40
Capital investment:			
Disbursement vouchers	$2,432,764.33		
Transfer vouchers received from other projects	78,469.22		
		2,511,233.55	
Less—			
Collections	363,726.21		
Collection vouchers, repayment refunds	72.55		
Transfer vouchers issued to other projects	94,383.49		
		458,182.25	
Net investment			2,053,151.30
Total liabilities, reserves, and capital investments of the Government			2,988,402.43

Operating expenses and revenues, Umatilla project, to June 30, 1916.

EXPENSES.

Storage works:		
Operation	$47,036.97	
Maintenance	43,158.15	
		$90,195.12
Canal system:		
Operation	81.80	
Maintenance	819.39	
		901.19
Lateral system:		
Operation	39,557.87	
Maintenance	96,920.50	
		136,478.37
Drainage system:		
Maintenance		6,513.30
Total		234,087.98

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	84,756.64
Operation and maintenance charges paid in advance by water-right applicants	3,360.79
Operation and maintenance charges paid and forfeited by water-right applicants	1,190.23

Penalties on operation and maintenance charges accrued on contracts with water-right applicants	$689.13
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	[1] 189.18
Rentals of irrigation water	8,477.94
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	19,447.78
Other revenues unclassified, earned during operating period	693.04
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	115,661.61
Total	234,087.98

Assets, liabilities, reserves, and capital, Klamath project, to June 30, 1916.

ASSETS.

Cash—Cash in special deposit account			$360.95
Inventory of stock on hand:			
Storehouse stock		$6,462.70	
Cement		569.17	
Structural iron and steel		1,178.38	
Lumber		1,585.56	
Explosives		2,026.44	
Forage in stock		2,710.32	
Fuel		1,231.26	
Freight and handling on inventory property		486.51	
			16,250.34
Accounts receivable:			
Construction charges due and uncollected from water-right applicants		4,360.69	
Construction charges unaccrued on contracts with water-right applicants		495,599.68	
Operation and maintenance charges due and uncollected from water-right applicants		5,657.88	
Uncollected rentals of irrigation water		142.50	
			505,760.75
Construction work in process:			
Gross cost of construction of project to date	$2,620,333.58		
Gross supplemental construction cost of project to date	72,457.98		
Gross operation and maintenance cost during construction	24,833.35		
Plant accounts	32,617.63		
		2,750,242.54	
Less revenues earned during construction—			
Rentals of buildings	30.00		
Rentals of grazing and farming lands	6,812.23		
Rentals of irrigation water	31,488.21		
Contractors' freight refunds	8,555.71		
Receipts from sale of town-site lots	811.22		
Other revenues, unclassified	47.54		
Total deductions		47,744.91	
Net cost of construction of project to date			2,702,497.63
Deferred operation and maintenance charges			66,033.67
Total assets			3,290,903.34

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[1] Deduct.

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid progress earnings under construction contracts		$640.75	
Unpaid labor		9,307.35	
Unpaid purchases		8,001.61	
Unpaid freight and express charges		2,043.96	
Unpaid passenger fares		21.65	
Unpaid agreements to purchase real property		281.50	
Guarantee and special deposits		360.95	
			$20,657.77
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		708,690.95	
Value of construction contracts with water-right applicants temporarily suspended		81,480.00	
Construction charges paid in advance by water-right applicants		677.28	
Construction charges paid and forfeited by water-right applicants		9.00	
Penalties paid on construction charges by water-right applicants		368.95	
			791,226.18
Capital investment:			
Disbursement vouchers	2,914,117.19		
Transfer vouchers received from other projects	85,853.89		
		$2,999,971.08	
Less—			
Collections	489,125.98		
Collection vouchers, repayment refunds	206.00		
Transfer vouchers issued to other projects	31,619.71		
Net investment		520,951.69	
			2,479,019.39
Total liabilities, reserves, and capital investments of the Government			3,290,903.34

Operating expenses and revenues, Klamath project, to June 30, 1916.

EXPENSES.

Canal system:		
Operation	$24,097.75	
Maintenance	28,368.93	
		$52,466.68
Lateral system:		
Operation	34,754.45	
Maintenance	97,335.39	
		132,089.84
Flood-protection system:		
Maintenance		9,831.69
Undistributed expenses:		
Operation	4,058.42	
Maintenance	5,028.57	
		9,086.99
Supplemental construction chargeable to operation and maintenance:		
Cost to Aug. 31, 1914		16,597.10
Total		220,072.30

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	$149,726.87
Operation and maintenance charges paid in advance by water-right applicants	875.21
Operation and maintenance charges paid and forfeited by water-right applicants	3.75
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	70.67
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	[1] 1,142.82
Rentals of irrigation water	3,235.00
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	1,269.95
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	66,033.67
Total	220,072.30

Assets, liabilities, reserves, and capital, Belle Fourche project, to June 30, 1916.

ASSETS.

Inventory of stock on hand:			
Storehouse stock		$12,052.04	
Cement		3,049.21	
Structural iron and steel		597.53	
Lumber		6,757.44	
Forage in stock		2,468.64	
Fuel		201.02	
			$25,125.88
Accounts receivable:			
Construction charges due and uncollected from water-right applicants		24,381.92	
Construction charges unaccrued on contracts with water-right applicants		1,728,010.56	
Operation and maintenance charges due and uncollected from water-right applicants		24,573.28	
Uncollected rentals of buildings		50.00	
Other uncollected items unclassified		49.20	
			1,777,064.96
Construction work contracted:			
Unearned value of construction work contracted			9,544.35
Construction work in process:			
Gross cost of construction of project to date	$3,406,244.43		
Plant accounts	14,306.99		
		3,420,551.42	
Less revenues earned during construction—			
Rentals of buildings	4,248.40		
Rentals of grazing and farming lands	2,661.90		
Rentals of telephones and tolls	87.48		
Contractors' freight refunds	2,616.22		
Forfeitures by defaulting bidders and contractors	7,337.50		
Receipts from sale of town-site lots	54,350.67		
Other revenues, unclassified	45.00		

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[1] Deduct.

Construction work in process—Contd.			
Less cost adjustments—			
Loss on mess-house operations.	[1] $3,459.57		
Profit on mercantile-store operations	1,688.16		
Profit on hospital operations	2,133.64		
Total deductions		$71,709.40	
Net cost of construction of project to date			$3,348,842.02
Deferred operation and maintenance charges			176,581.46
Total assets			5,337,158.67

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid progress earnings under construction contracts		$8,162.98	
Unpaid contract holdbacks		1,589.96	
Unpaid labor		7,295.96	
Unpaid purchases		4,566.13	
Unpaid freight and express charges		10,806.90	
Unpaid passenger fares		45.55	
Unredeemed meal tickets		278.70	
Other unpaid items unclassified		3,355.71	
			36,101.89
Contingent obligations:			
Unearned value of construction work contracted			9,544.35
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		1,883,106.14	
Value of construction contracts with water-right applicants temporarily suspended		31,580.40	
Construction charges paid in advance by water-right applicants		4,905.47	
Construction charges paid and forfeited by water-right applicants		619.15	
Penalties paid on construction charges by water-right applicants		1,395.36	
			1,921,606.52
Capital investment:			
Disbursement vouchers	$3,699,551.28		
Transfer vouchers received from other projects	97,937.61		
		3,797,488.89	
Less—			
Collections	391,703.95		
Collection vouchers, repayment refunds	265.87		
Transfer vouchers issued to other projects	37,938.35		
		429,908.17	
Net investment			3,367,580.72
Revenue in excess of cost of operation and maintenance			2,325.19
Total liabilities, reserves, and capital investments of the Government			5,337,158.67

Operating expenses and revenues, Belle Fourche project, to June 30, 1916.

EXPENSES.

Storage works:		
Operation	$13,636.89	
Maintenance	46,528.79	
		$60,165.68

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[1] Deduct.

Canal system:		
Operation	$21,208.50	
Maintenance	64,167.92	
		$85,376.42
Lateral system:		
Operation	38,039.78	
Maintenance	140,222.02	
		178,261.80
Drainage system:		
Maintenance		3,624.44
Undistributed expenses:		
Operation	2,808.90	
Maintenance	12,782.67	
		15,591.57
Supplemental construction chargeable to operation and maintenance:		
Cost to August 31, 1914	2,735.60	
Cost since Sept. 1, 1914	326.86	
		3,062.46
Revenues in excess of cost of operation and maintenance		2,325.19
Total		348,407.56

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	$156,151.43
Operation and maintenance charges paid in advance by water-right applicants	175.83
Operation and maintenance charges paid and forfeited by water-right applicants	503.85
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	481.38
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	[1] 814.75
Rental of land and buildings during operating period	430.00
Rentals of irrigation water	1,874.14
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	13,003.17
Other revenues unclassified, earned during operating period	21.05
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	176,581.46
Total	348,407.56

Assets, liabilities, reserves, and capital, Strawberry Valley project, to June 30, 1916.

ASSETS.

Cash:		
In special fiscal agent's possession, awaiting remittance	$14.86	
Cash in special deposit account	15,313.95	
		$15,328.81
Inventory of stock on hand:		
Storehouse stock	24,462.76	
Products of local operations	51.80	
Freight and handling on inventory property	2,134.95	
		26,649.51
Accounts receivable:		
Construction charges due and uncollected from water-right applicants	591.81	
Construction charges unaccrued on contracts with water-right applicants	1,710,828.37	
Operation and maintenance charges due and uncollected from water-right applicants	89.56	

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[1] Deduct.

Accounts receivable—Continued.			
Uncollected rentals of power and light		$1,087.80	
Other uncollected items unclassified		3,163.57	
Unadjusted transfers to other projects		58.91	
			$1,715,820.02
Construction work in process:			
Gross cost of construction of project to date	$3,106,910.82		
Gross operation and maintenance cost during construction	27,171.66		
Plant accounts	58,867.26		
		3,192,949.74	
Less revenues earned during construction—			
Rentals of buildings	5,922.80		
Rentals of grazing and farming lands	62,005.25		
Rentals of power and light	32,411.00		
Rentals of irrigation water	678.00		
Rentals of telephones and tolls	1,431.06		
Contractors' freight refunds	46.06		
Forfeitures by defaulting bidders and contractors	270.00		
Less cost adjustments—			
Profit on mess-house operations	5,026.36		
Profit on mercantile store operations	9,235.29		
Loss on hospital operations	[1] 2,358.79		
Total deductions		114,667.03	
Net cost of construction of project to date			3,078,282.71
Deferred operation and maintenance charges			4,374.06
Total assets			4,840,455.11

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid progress earnings under construction contracts		$36,250.35	
Unpaid labor		4,792.69	
Unpaid purchases		5,245.55	
Unpaid freight and express charges		4,073.16	
Unpaid passenger fares		23.80	
Unpaid agreements to purchase real property		172.97	
Unredeemed coupon books		73.05	
Guarantee and special deposits		15,313.95	
Other unpaid items unclassified		648.90	
			66,594.42
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants			1,731,249.13
Capital investment:			
Disbursement vouchers	$3,190,892.12		
Joint construction vouchers received	17,783.16		
Transfer vouchers received from other projects	102,133.06		
		3,310,808.34	

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[1] Deduct.

Capital investment—Continued.			
Less—			
Collections	$217,753.45		
Transfer vouchers issued to other projects	50,443.33		
		$268,196.78	
Net investment			$3,042,611.56
Total liabilities, reserves, and capital investments of the Government			4,840,455.11

Operating expenses and revenues, Strawberry Valley project, to June 30, 1916.

EXPENSES.

Storage works:		
Operation	$1,862.64	
Maintenance	4,000.81	
		$5,863.45
Canal system:		
Operation	4,617.21	
Maintenance	5,686.06	
		10,303.27
Lateral system:		
Operation		1,337.36
Power system:		
Operation	4,357.50	
Maintenance	1,102.22	
		5,459.72
Flood protection system:		
Operation		148.56
Undistributed expenses:		
Operation	2,389.68	
Maintenance	2,684.30	
		5,073.98
Total		28,186.34

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	5,441.59
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	1.73
Discounts allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	[1] 224.46
Rental of land and buildings during operating period	228.00
Rentals of grazing and farming lands during operating period	14,549.20
Rentals of power and light during operating period	4,091.72
Rental of telephone and tolls during operating period	51.43
Other revenues unclassified, earned during operating period	[1] 326.93
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	4,374.06
Total	28,186.34

Assets, liabilities, reserves, and capital, Okanogan project, to June 30, 1916.

ASSETS.

Inventory of stock on hand:		
Storehouse stock	$1,635.10	
Cement	3,835.80	
Structural iron and steel	2,394.97	
Lumber	472.47	
		$8,338.34

---

[1] Deduct.

Accounts receivable:			
Construction charges due and uncollected from water-right applicants		$51,609.11	
Operation and maintenance charges due and uncollected from water-right applicants		58.50	
Uncollected rentals of irrigation water		17,280.61	
Unadjusted transfers to other projects		146.56	
			$69,094.78
Construction work in process:			
Gross cost of construction of project to date	$807,741.06		
Gross operation and maintenance cost during construction	4,736.36		
Plant accounts	1,869.91		
		814,347.33	
Less revenues earned during construction—			
Rentals of buildings	224.00		
Rentals of grazing and farming lands	540.00		
Rentals of irrigation water	1,670.50		
Less cost adjustments—			
Loss on mess-house operations	[1] 193.83		
Profit on hospital operations	332.78		
Total deductions		2,573.45	
Net cost of construction of project to date			811,773.88
Total assets			889,207.00

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor		$1,688.86	
Unpaid purchases		3,719.42	
Unpaid freight and express charges		3,020.49	
Unpaid passenger fares		48.50	
			8,477.27
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		68,198.66	
Construction charges paid in advance by water-right applicants		8,033.00	
			76,231.66
Capital investment:			
Disbursement vouchers	$880,215.82		
Transfer vouchers received from other projects	37,921.31		
		918,137.13	
Less -			
Collections	149,360.56		
Collection vouchers, repayment refunds	52.50		
Transfer vouchers issued to other projects	10,404.91		
		159,817.97	
Net investment			758,319.16
Revenue in excess of cost of operation and maintenance			46,178.91
Total liabilities, reserves, and capital investments of the Government			889,207.00

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[1] Deduct.

EXPENSES.

Storage works:		
Operation	$6,152.20	
Maintenance	826.50	
		$6,978.70
Lateral system:		
Operation	17,995.50	
Maintenance	37,113.50	
		55,109.00
Undistributed expenses:		
Operation	9,937.80	
Maintenance	15,271.26	
		25,209.06
Revenues in excess of cost of operation and maintenance (carried to credit side of assets; liabilities, reserves, and capital statement)		46,178.91
Total		133,475.67

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants—	36,300.89
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	314.81
Rental of land and buildings during operating period	1,667.12
Rentals of irrigation water	95,192.85
Total	133,475.67

Assets, liabilities, reserves, and capital, Yakima storage project, to June 30, 1916.

ASSETS.

Cash:			
In other employees' hands, awaiting transfer to special fiscal agents			$390.00
Inventory of stock on hand:			
Stores issued and not used		$4,402.90	
Storehouse stock		51,504.79	
Cement		2,772.70	
Structural iron and steel		4,503.62	
Lumber		633.88	
Explosives		4,683.19	
Forage in stock		276.79	
Fuel		1,332.69	
Products of local operations		13,871.53	
			83,982.09
Accounts receivable:			
Other uncollected items unclassified		786.87	
Unadjusted transfers to other projects		28.70	
			815.57
Construction work in process:			
Gross cost of construction of project to date	$2,172,734.01		
Gross operation and maintenance cost during construction	8,307.84		
Plant accounts	61,542.39		
		2,242,584.24	
Less revenues earned during construction—			
Rentals of buildings	21,346.92		
Rentals of grazing and farming lands	51.00		
Rentals of power and light	1,385.47		
Rentals of irrigation water	14,305.00		
Rentals of telephones and tolls	22.80		
Other revenues, unclassified	40,454.95		

Construction work in process—Contd.			
Less cost adjustments—			
Profit on mess house operations	$41,063.88		
Profit on mercantile store operations	12,663.63		
Profit on hospital operations	1,306.94		
Total deductions		$132,600.59	
Net cost of construction of project to date			$2,109,983.65
Total assets			2,195,171.31

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor		$24,062.61	
Unpaid purchases		19,871.76	
Unpaid freight and express charges		7,011.60	
Unpaid passenger fares		177.95	
Unredeemed coupon books		761.80	
Unadjusted transfers from other projects		2.15	
			51,887.87
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		630.00	
Miscellaneous accruals, charges accrued on contracts with Indian Service		200,000.00	
			200,630.00
Capital investment:			
Disbursement vouchers	$2,053,245.36		
Transfer vouchers received from other projects	201,571.86		
		2,254,817.22	
Less—			
Collections	276,815.63		
Transfer vouchers issued to other projects	35,348.15		
		312,163.78	
Net investment			1,942,653.44
Total liabilities, reserves, and capital investments of the Government			2,195,171.31

Assets, liabilities, reserves, and capital, Yakima-Sunnyside project, to June 30, 1916.

ASSETS.

Inventory of stock on hand:		
Storehouse stock	$8,832.28	
Cement	4,265.66	
Lumber	1,124.88	
Explosives	271.62	
Forage in stock	115.21	
Fuel	53.77	
Freight and handling on inventory property	[1] 2,462.35	
		$12,201.07
Accounts receivable:		
Construction charges due and uncollected from water-right applicants	31,823.70	
Construction charges unaccrued on contracts with water-right applicants	1,022,323.96	
Operation and maintenance charges due and uncollected from water-right applicants	34,541.01	
Uncollected freight refunds	724.77	
Other uncollected items unclassified	227.70	
Unadjusted transfers to other projects	[1] 383.41	
		1,089,257.73

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[1] Deduct.

Unearned value of construction work contracted			$7,063.30
Construction work in process:			
Gross cost of construction of project to date	$2,921,760.26		
Gross supplemental construction cost of project to date	2,606.40		
Gross operation and maintenance cost during construction	7,584.70		
Plant accounts	8,967.20		
		$2,940,918.56	
Less revenue earned during construction—			
Rentals of buildings	3,260.67		
Contractors' freight refunds	10,158.12		
Forfeitures by defaulting bidders and contractors	5,391.16		
Less cost adjustments—			
Profit on mess house operations	3,768.01		
Profit on mercantile store operations	2,917.75		
Profit on hospital operations	974.98		
Total deductions		26,470.69	
Net cost of construction of project to date			2,914,447.87
Deferred operation and maintenance charges			37,826.71
Total assets			4,060,796.68

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid contract holdbacks		$3,732.75	
Unpaid labor		6,104.03	
Unpaid purchases		3,034.57	
Unpaid freight and express charges		5,044.61	
Unpaid passenger fares		36.65	
Unpaid agreements to purchase real property		100.00	
Unadjusted transfers from other projects		16.65	
			18,069.26
Contingent obligations:			
Unearned value of construction work contracted			7,063.30
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		1,729,424.03	
Value of construction contracts with water-right applicants temporarily suspended		3,952.00	
Construction charges paid in advance by water-right applicants		4,953.15	
Construction charges paid and forfeited by water-right applicants		180.00	
Penalties paid on construction charges by water-right applicants		5,930.53	
			1,744,439.71
Capital investment:			
Disbursement vouchers	$3,658,061.20		
Transfer vouchers received from other projects	40,752.59		
		3,698,813.79	

Capital investment—Continued.			
Less—			
Collections	$1,327,543.54		
Collection vouchers, repayment refunds	2,589.18		
Transfer vouchers issued to other projects	77,456.66		
		$1,407,589.38	
Net investments			$2,291,224.41
Total liabilities, reserves, and capital investments of the Government			4,060,796.68

Assets, liabilities, reserves, and capital, Yakima-Tieton project to June 30, 1916.

ASSETS.

Inventory of stock on hand:			
Stores issued and not used		$250.99	
Storehouse stock		1,509.92	
Cement		1,956.41	
Structural iron and steel		100.00	
Lumber		300.00	
Forage in stock		252.59	
Products of local operations		348.25	
Freight and handling on inventory property		[1] 938.05	
			$3,780.11
Accounts receivable:			
Construction charges due and uncollected from water-right applicants		18,542.57	
Construction charges unaccrued on contracts with water-right applicants		2,430,653.21	
Operation and maintenance charges due and uncollected from water-right applicants		15,254.88	
Unadjusted transfers to other projects		[1] 252.17	
			2,464,198.49
Construction work in process:			
Gross cost of construction of project to date	$3,159,422.93		
Gross operation and maintenance cost during construction	10,208.54		
		3,169,631.47	
Less revenues earned during construction—			
Rentals of buildings	4,827.35		
Rentals of power and light	3,526.50		
Contractors' freight refunds	5,092.12		
Less cost adjustments—			
Loss on mess-house operations	[1] 1,131.79		
Profit on mercantile store operations	9,992.83		
Profit on hospital operations	2,185.94		
Total deductions		24,492.95	
Net cost of construction of project to date			3,145,138.52
Deferred operation and maintenance charges			11,097.14
Total costs			5,624,214.26

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:		
Unpaid labor	$2,170.52	
Unpaid purchases	2,008.60	
Unpaid freight and express charges	914.09	

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[1] Deduct.

Unpaid passenger fares		$45.89	
Unredeemed coupon books		17.15	
Other unpaid items unclassified		7.06	
			$5,163.31
Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		2,702,223.43	
Value of construction contracts with water-right applicants temporarily suspended		14,415.00	
Construction charges paid in advance by water-right applicants		1,031.08	
Construction charges paid and forfeited by water right applicants		21.60	
Penalties paid on construction charges by water-right applicants		2,382.96	
			2,720,074.07
Capital investment:			
Disbursement vouchers	$3,260,069.24		
Transfer vouchers received from other projects	464,700.11		
		3,724,769.35	
Less—			
Collections	496,644.98		
Collection vouchers, repayment refunds	762.60		
Transfer vouchers issued to other projects	328,384.89		
		825,792.47	
Net investment			2,898,976.88
Total liabilities, reserves, and capital investments of the Government			5,624,214.26

Operating expenses and revenues Yakima-Sunnyside project, to June 30, 1916.

EXPENSES.

Storage works:		
Operation	$1,264.91	
Maintenance	1,534.55	
		$2,799.46
Canal system:		
Operation	126,242.39	
Maintenance	231,827.31	
		358,069.70
Lateral system:		
Operation	92,179.08	
Maintenance	186,073.54	
		278,252.62
Undistributed expenses:		
Operation	1,016.22	
Maintenance	36,770.29	
		37,786.51
Total		676,908.29

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	577,856.98
Operation and maintenance charges paid in advance by water-right applicants	456.44
Operation and maintenance charges paid and forfeited by water-right applicants	23.92
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	5,675.96

Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	[1] $721.27
Rental of land and buildings during operating period	2,075.40
Rentals of grazing and farming lands during operating period	15.00
Rentals of power and light during operating period	1,869.20
Rentals of irrigation water	39,931.63
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	10,714.25
Other revenues unclassified, earned during operating period	1,184.82
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	37,825.96
Total	676,908.29

Operating expenses and revenues, Yakima-Tieton project, to June 30, 1916.

EXPENSES.

Storage works:		
Operation	$6,941.90	
Maintenance	1,762.87	
		$8,704.77
Canal system:		
Operation	12,240.21	
Maintenance	19,590.78	
		31,830.99
Lateral system:		
Operation	56,027.40	
Maintenance	80,775.57	
		136,802.97
Undistributed expenses:		
Operation	2,796.01	
Maintenance	29,823.10	
		32,619.11
Total		209,957.84

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	165,517.65
Operation and maintenance charges paid in advance by water-right applicants	159.55
Operation and maintenance charges paid and forfeited by water-right applicants	12.00
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	17.07
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants (contra)	[1] 1,040.92
Rental of land and buildings during operating period	4,722.38
Rentals of grazing and farming lands during operating period	522.00
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	28,950.97
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	11,097.14
Total	209,957.84

Assets, liabilities, reserves, and capital, Shoshone project, to June 30, 1916.

ASSETS.

Cash:		
Cash in special deposit account		$1,600.02
Inventory of stock on hand:		
Storehouse stock	$42,234.62	
Cement	2,772.70	
Structural iron and steel	5,890.49	

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[1] Deduct.

Lumber		$14, 930. 31	
Explosives		100. 96	
Fuel		689. 74	
Products of local operations		118. 82	
Freight and handling on inventory property		410. 87	
			$67, 148. 51
Accounts receivable:			
Construction charges due and uncollected from water-right applicants		5, 709. 25	
Construction charges unaccrued on contracts with water-right applicants		1, 676, 419. 69	
Operation and maintenance charges due and uncollected from water-right applicants		9, 559. 51	
Uncollected freight refunds		1, 529. 05	
Other uncollected items, unclassified		15, 631. 06	
			1, 708, 848. 56
Construction work contracted:			
Unearned value of construction work contracted			58, 926. 46
Construction work in process:			
Gross cost of construction of project to date	$4, 074, 502. 97		
Gross supplemental construction cost of project to date	468, 477. 16		
Plant accounts	38, 443. 52		
		4, 581, 423. 65	
Less revenues earned during construction—			
Rentals of buildings	12, 402. 31		
Rentals of grazing and farming lands	2, 181. 30		
Rentals of telephones and tolls	145. 75		
Contractors' freight refunds	19, 355. 59		
Forfeitures by defaulting bidders and contractors	34, 860. 08		
Receipts from sale of town-site lots	51, 728. 40		
Other revenues, unclassified	1, 150. 57		
Less cost adjustments—			
Loss on mess-house operations	[1] 10, 222. 18		
Profit on mercantile store operations	3, 252. 00		
Profit on hospital operations	381. 02		
Total deductions		115, 234. 84	
Net cost of construction of project to date			4, 466, 188. 81
Deferred operation and maintenance charges			79, 705. 51
Total assets			6, 382, 417. 87

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:		
Unpaid progress earnings under construction contracts	$12, 252. 16	
Unpaid contract holdbacks	5, 544. 55	
Unpaid labor	9, 556. 32	
Unpaid purchases	11, 731. 66	
Unpaid freight and express charges	20, 865. 23	
Unpaid passenger fares	283. 85	
Unpaid agreements to purchase real property	250. 00	
Guarantee and special deposits	1, 600. 02	
Other unpaid items, unclassified	10, 164. 23	
		72, 248. 02
Contingent obligations:		
Unearned value of construction work contracted		58, 926. 46

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[1] Deduct.

Reserves for repayment to reclamation fund of cost of project:			
Value of construction contracts with water-right applicants		$1,837,312.13	
Value of construction contracts with water-right applicants temporarily suspended		105,240.26	
Construction charges paid in advance by water-right applicants		4,446.31	
Construction charges paid and forfeited by water-right applicants		2,560.43	
Penalties paid on construction charges by water-right applicants		727.12	
			$1,950,286.25
Capital investment:			
Disbursement vouchers	$4,755,600.97		
Transfer vouchers received from other projects	182,318.88		
		4,937,919.85	
Less—			
Collections	583,826.25		
Collection vouchers, repayment refunds	1,444.54		
Joint construction vouchers issued	51,691.92		
		636,962.71	
Net investment			4,300,957.14
Total liabilities, reserves, and capital investments of the Government			6,382,417.87

Operating expenses and revenues Shoshone project, to June 30, 1916.

EXPENSES.

Storage works:		
Operation	$12,035.98	
Maintenance	10,749.50	
		$22,785.48
Canal system:		
Operation	23,843.40	
Maintenance	19,382.19	
		43,225.59
Lateral system:		
Operation	48,370.20	
Maintenance	39,238.93	
		87,609.13
Drainage system:		
Operation	1,849.95	
Maintenance	4,272.13	
		6,122.08
Flood protection system:		
Maintenance		1,841.51
Undistributed expenses:		
Operation and maintenance		7,596.34
Supplemental construction chargeable to operation and maintenance:		
Cost to Aug. 31, 1914	41,089.04	
Cost since Sept. 1, 1914	8,123.76	
		49,212.80
Total		218,392.93

REVENUES.

Operation and maintenance charges accrued on contracts with water-right applicants	133,113.54
Operation and maintenance charges paid in advance by water-right applicants	3,125.11

applicants	$1,378.16
Penalties on operation and maintenance charges accrued on contracts with water-right applicants	749.09
Discount allowed on operation and maintenance charges accrued on contracts with water-right applicants	[1] 597.54
Rentals of irrigation water	571.31
Accrued and unpaid operation and maintenance accruals transferred to and added to construction charges	147.75
Deferred operation and maintenance charges (carried to debit side of assets, liabilities, reserves, and capital statement)	79,705.51
Total	218,392.93

Assets, liabilities, reserves, and capital, secondary projects, to June 30, 1916.

ASSETS.

Inventory of stock on hand: Storehouse stock			$6,577.76
Accounts receivable: Other uncollected items unclassified			455.16
Construction work in process:			
Gross cost of construction of project to date		$1,021,667.69	
Less cost adjustments—			
Loss on mess-house operations	[1] $2,442.66		
Profit on hospital operations	394.50		
Total deductions		[1] 2,048.16	
Net cost of construction of project to date			1,023,715.85
Total assets			1,030,748.77

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor		$526.50	
Unpaid purchases		2,554.53	
Unpaid freight and express charges		197.23	
Unpaid passenger fares		609.19	
			3,887.45
Capital investment:			
Disbursement vouchers	$964,368.47		
Transfer vouchers received from other projects	175,283.95		
		1,139,652.42	
Less—			
Collections	34,764.24		
Transfer vouchers issued to other projects	78,026.86		
		112,791.10	
Net investment			1,026,861.32
Total liabilities, reserves, and capital investments of the Government			1,030,748.77

Assets, liabilities, reserves, and capital, Washington office, to June 30, 1916.

ASSETS.

Cash:		
In special fiscal agent's possession, awaiting remittance	$45.50	
Cash in special deposit account	84,140.58	
		$84,186.08

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[1] Deduct.

Inventory of stock on hand:			
Storehouse stock		$42,200.83	
Goods in transit		271.08	
Freight and handling on inventory property		5,400.68	
			$47,872.59
Accounts receivable:			
Uncollected items unclassified		10,232.40	
Unadjusted transfers to projects		.50	
			10,232.90
Cost:			
Undistributed to date	$120.09		
Equipment	26,882.27		
		27,002.36	
Less revenues earned—			
Rentals of telephones and tolls	404.74		
Other revenues, unclassified	2,415.65		
Total deductions		2,820.39	
Net cost of inventory to date			24,181.97
Total assets			166,473.54

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor		$2,094.75	
Unpaid purchases		7,941.45	
Unpaid freight and express charges		305.89	
Unpaid passenger fares		1,883.07	
Guaranty and special deposits		84,140.58	
Other unpaid items unclassified		780.38	
			97,146.12
Capital investment:			
Disbursement vouchers	$3,186,365.53		
Transfer vouchers received from projects	140,277.53		
		3,326,643.06	
Less—			
Collections	45,123.48		
Transfer vouchers issued to projects	3,212,192.16		
		3,257,315.64	
Net investment			69,327.42
Total liabilities, reserves, and capital investments of the Government			166,473.54

Functional feature costs of Washington office to June 30, 1916.

Features:		
Examinations and surveys		$120.09
Equipment		26,882.27
Gross cost to June 30, 1916		27,002.36
Less revenues earned:		
Rentals of telephones and tolls	$404.74	
Other revenues, unclassified	2,415.65	
		2,820.39
Net cost of inventory to June 30, 1916		24,181.97

1917.

Salaries and wages	$238, 315
Books, stationery, printing, and office supplies	12, 890
Furniture and fixtures—office	2, 200
Rental of offices	9, 240
Telephone service	1, 025
Telegraph service	5, 000
Heat, light, and power	1, 200
Traveling expenses	26, 168
Books, stationery, printing, and drafting supplies for issue to field offices	42, 322
Instruments, surveying, engineering, and mechanical for issue to field offices	6, 000
Total	344, 360

Assets, liabilities, reserves, and capital, Denver office, to June 30, 1916.

ASSETS.

Inventory of stock on hand:		
Storehouse stock	$19, 331. 50	
Freight and handling on inventory property	[1] 104. 26	
		$19, 227. 24
Accounts receivable—Unadjusted transfers to projects		4, 460. 49
Undistributed cost to date	$85, 480. 80	
Less cost adjustments, loss on hospital operations	[1] 1. 15	
Net cost of inventory to date		85, 481. 95
Total assets		109, 169. 68

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid labor		$1, 247. 56	
Unpaid purchases		718. 86	
Unpaid freight and express charges		376. 66	
Unpaid passenger fares		1, 641. 59	
Unadjusted transfers from projects		85, 480. 80	
			89, 465. 47
Capital investment:			
Disbursement vouchers	$82, 375. 92		
Transfer vouchers received from projects	27, 545. 13		
		109, 921. 05	
Less—			
Collections	2, 280. 24		
Transfer vouchers issued to projects	87, 936. 60		
		90, 216. 84	
Net investment			19, 704. 21
Total liabilities, reserves, and capital investments of the Government			109, 169. 68

Functional feature cost of the Denver office to June 30, 1916

Features:	
Examination and surveys	$85, 480. 80
Less revenues earned, loss on hospitals	[1] 1. 15
Net cost of inventory to June 30, 1916	85, 481. 95

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[1] Deduct.

Estimated cost of contemplated work for Denver office during fiscal year 1917.

Salaries and wages	$112,320
Books, stationery, printing, and office supplies	8,760
Furniture and fixtures	1,500
Office rent	5,000
Telegraph service	3,000
Telephone service	250
Ice water and towel service	250
Travel	18,000
Drayage	250
Total	149,330

Assets, liabilities, reserves, and capital, Blackfeet (Indian) project, to June 30, 1916.

ASSETS.

Cash:			
In special fiscal agent's possession, awaiting remittance			$3.14
Inventory of stock on hand:			
Stores issued and not used		$625.30	
Storehouse stock		550.58	
Cement		514.84	
Structural iron and steel		941.51	
Lumber		564.31	
Forage in stock		10.14	
Products of local operations		8.85	
Freight and handling on inventory property		330.94	
			3,546.47
Accounts receivable:			
Uncollected freight refunds		10.66	
Other uncollected items unclassified		12.75	
Unadjusted transfers to other projects		499.35	
			522.76
Construction work in process:			
Gross cost of construction of project to date	$956,457.75		
Gross operation and maintenance cost during construction	23,690.09		
Plant accounts	1,248.62		
		981,396.46	
Less revenues earned during construction—			
Rentals of buildings	839.65		
Rentals of telephones and tolls	714.60		
Contractors' freight refunds	36.04		
Other revenues, unclassified	7.50		
Less cost adjustments—			
Profit on mess-house operations	7,950.16		
Profit on mercantile-store operations	18,955.99		
Profit on hospital operations	628.33		
Total deductions		29,132.27	
Net cost of construction of project to date			952,264.19
Total assets			956,336.56

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:		
Unpaid labor	$1,569.22	
Unpaid purchases	1,192.09	
Unpaid freight and express charges	191.34	
Unpaid passenger fares	3.85	
		2,956.50
Reserves for repayment to reclamation fund of cost of project:		
Miscellaneous accruals, charges accrued on contracts with Indian Service		928,380.14

Disbursement vouchers	$952,530.40		
Transfer vouchers received from other projects	109,379.18		
		$1,061,909.58	
Less—			
Collection vouchers, repayment refunds	952,469.17		
Transfer vouchers issued to other projects	84,440.49		
		1,036,909.66	
Net investment			$24,999.92
Total liabilities, reserves, and capital investments of the Government			956,336.56

Assets, liabilities, reserves, and capital, Flathead (Indian) project, to June 30, 1916.

ASSETS.

Cash:			
In other employees' hands, awaiting transfer to special fiscal agents			$16.17
Inventory of stock on hand:			
Stores issued and not used		$865.86	
Storehouse stock		16,621.61	
Cement		3,647.98	
Explosives		301.62	
Forage in stock		1,733.37	
Products of local operations		13,368.42	
Freight and handling on inventory property		15.81	
			36,594.67
Accounts receivable:			
Uncollected rentals of irrigation water		12,784.82	
Other uncollected items unclassified		473.14	
Unadjusted transfers to other projects		49.63	
			13,307.59
Construction work contracted:			
Unearned value of construction work contracted			3,248.15
Construction work in process:			
Gross cost of construction of project to date	$1,676,292.01		
Gross operation and maintenance cost during construction	98,244.08		
Plant accounts	26,721.78		
		1,801,257.87	
Less revenues earned during construction—			
Rentals of buildings	3,555.47		
Rentals of grazing and farming lands	810.75		
Rentals of irrigation water	29,675.02		
Rentals of telephones and tolls	5,104.96		
Contractors' freight refunds	2,072.04		
Forfeitures by defaulting bidders and contractors	990.00		
Other revenues, unclassified	344.19		
Less cost adjustments—			
Profit on mess-house operations	12,097.51		
Profit on mercantile-store operations	8,525.50		
Profit on hospital operations	1,146.79		
Total deductions		64,322.23	
Net cost of construction of project to date			1,736,935.64
Total assets			1,790,102.22

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid progress earnings under construction contracts		$22,568.96	
Unpaid contract holdbacks		6,644.00	
Unpaid labor		7,592.75	
Unpaid purchases		16,352.34	
Unpaid freight and express charges		7,172.53	
Unpaid passenger fares		29.30	
			$60,359.88
Contingent obligations:			
Unearned value of construction work contracted			3,248.15
Reserves for repayment to reclamation fund of cost of project:			
Construction charges paid in advance by water-right applicants		387.14	
Discounts allowed		55.39	
Charges accrued on contracts with Indian Service.		1,502,735.27	
			1,503,107.80
Capital investment:			
Disbursement vouchers	$1,758,441.43		
Joint construction vouchers received	353.10		
Transfer vouchers received from other projects	85,547.50		
		1,844,342.03	
Less—			
Collections	1,574,078.21		
Joint construction vouchers issued	353.10		
Transfer vouchers issued to other projects	46,594.33		
		1,621,025.64	
Net investment			223,316.39
Total liabilities, reserves, and capital investments of the Government			1,790,102.22

Assets, liabilities, reserves, and capital, Fort Peck (Indian) project, to June 30, 1916.

ASSETS.

Cash:			
In special fiscal agent's possession, awaiting remittance			$6.45
Inventory of stock on hand:			
Stores issued and not used (mercantile store stock).		$2,186.19	
Storehouse stock		2,123.81	
Cement		634.92	
Structural iron and steel		581.05	
Lumber		279.32	
Forage in stock		473.40	
Fuel		38.82	
Products of local operations		973.89	
Freight and handling on inventory property		657.65	
			7,949.[illegible]5
Accounts receivable:			
Other uncollected items unclassified		4,509.82	
Unadjusted transfers to other projects		536.57	
			5,046.39
Construction work in process:			
Gross cost of construction of project to date	$470,709.00		
Gross operation and maintenance cost during construction	14,584.55		
Plant accounts	10,570.07		
		495,863.62	

Less revenues earned during construction—			
Rentals of buildings	$331.01		
Other revenues, unclassified	773.30		
Less cost adjustments—			
Loss on mess-house operations	[1] 434.57		
Profit on mercantile store operations	9,136.88		
Profit on hospital operations	408.34		
Total deductions		$10,214.96	
Net cost of construction of project to date			$485,648.66
Total assets			498,650.55

LIABILITIES, RESERVES, AND CAPITAL.

Accounts payable:			
Unpaid purchases		$632.46	
Unpaid freight and express charges		1,371.90	
Unpaid passenger fares		86.25	
Unredeemed coupon books		98.66	
Other unpaid items unclassified		2,197.14	
			4,386.41
Reserves for repayment to reclamation fund of cost of project: Miscellaneous accruals, charges accrued on contracts with Indian service			463,034.27
Capital investment:			
Disbursement vouchers	$470,700.71		
Transfer vouchers received from other projects	40,897.01		
		511,597.72	
Less—			
Collection vouchers, repayment refunds	464,179.25		
Transfer vouchers issued to other projects	16,188.60		
Net investment		480,367.85	
			31,229.87
Total liabilities, reserves, and capital investments of the Government			498,650.55

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[1] Deduct.

RECEIPTS, ALLOTMENTS, AND INVESTMENT, BY STATES.

The table following gives a statement of additions to the reclamation fund from the sale of public lands, by States, and also shows the amounts allotted and the net investment of the Government for irrigation work in each of the reclamation States.

TABLE 1.—*Reclamation fund accretions from the sale of public lands, allotments, and net investment, by States.*

States.	Actual receipts from sales of public land, exclusive of town-site sales, transferred to credit of reclamation fund.		Estimated receipts with Treasurer United States on June 30, 1916, not yet audited.	Total estimated receipts from sales of public land, exclusive of town-site sales, to June 30, 1916.
	Fiscal year 1916.	Total to June 30, 1916		
Arizona	$88,021.17	$1,372,151.22	$58,600.00	$1,430,751.22
California	181,157.29	5,953,831.91	159,000.00	6,112,831.91
Colorado	441,148.52	7,561,626.96	202,000.00	7,763,626.96
Idaho	221,384.62	5,557,795.39	122,400.00	5,680,195.39
Kansas	16,400.84	996,257.66	9,000.00	1,005,257.66
Montana	821,081.59	10,885,802.63	381,600.00	11,267,402.63
Nebraska	46,711.00	1,845,270.15	23,400.00	1,868,670.15
Nevada	36,467.68	638,467.25	18,000.00	656,467.25
New Mexico	184,434.96	4,413,322.88	108,000.00	4,521,322.88
North Dakota	51,498.08	12,08[illegible],994.05	25,000.00	12,114,994.05
Oklahoma	17,212.34	5,83[illegible],369.06	10,800.00	5,850,169.06
Oregon	151,018.09	10,771,327.48	64,800.00	10,836,127.48
South Dakota	127,139.98	7,186,199.95	66,600.00	7,252,799.95
Utah	146,214.64	2,076,556.93	32,000.00	2,108,556.93
Washington	312,467.13	6,901,957.37	32,000.00	6,933,957.37
Wyoming	207,580.32	4,874,500.72	110,700.00	4,985,200.72
Total	3,049,938.25	88,964,431.61	1,423,900.00	90,388,331.61

States.	Allotments.		Net investment.	
	Fiscal year 1916.	Total to June 30, 1916	Fiscal year 1916.	Total to June 30, 1916.
Arizona	$1,262,591.50	$22,020,800.76	$428,973.22	$17,393,367.27
California	252,631.53	3,516,874.51	191,415.37	2,979,219.89
Colorado	979,284.06	9,971,659.81	785,702.50	8,854,743.51
Idaho	1,368,106.89	20,449,818.50	659,563.73	16,572,239.83
Kansas	1,592.77	397,592.77	55.52	376,240.79
Montana	1,803,339.33	13,366,269.95	1,725,894.07	11,317,635.01
Nebraska	641,398.86	5,926,675.87	189,738.43	4,797,893.49
Nevada	190,119.11	6,676,622.74	[1] 1,010.85	5,786,828.44
New Mexico	713,593.21	5,783,075.24	570,417.10	4,681,546.66
North Dakota	34,113.30	2,353,503.57	[1] 3,805.97	1,973,885.18
Oklahoma	41,022.28	167,522.72	902.21	79,389.84
Oregon	467,271.02	5,129,325.80	344,037.61	4,102,849.93
South Dakota	143,949.27	3,873,541.00	54,696.88	3,384,398.76
Texas	405,683.20	2,704,483.20	331,382.73	2,209,086.96
Utah	432,300.00	3,673,318.37	453,100.34	3,095,629.93
Washington	1,116,330.46	11,586,816.14	408,657.63	8,054,533.50
Wyoming	699,044.92	7,754,562.30	297,707.22	6,367,332.91
Secondary projects	....	154,072.89	....	....
General accounts	178,715.07	7,176,548.42	[1] 1,685.59	124,634.17
Total	10,731,086.78	132,683,084.56	6,435,742.15	102,151,456.07

[1] Credit.

ALLOTMENTS AND NET INVESTMENT, BY PROJECTS AND BY STATES.

This statement shows the amount of money allotted to each project, the amount of money expended on each project to June 30, 1916, and the amount of money allotted to States and expended in the respective States for the same period:

TABLE 2.—*Statement of project allotments and net investments, by States, to June 30, 1916.*

State and project.	Per cent chargeable to State.	Allotments.		Net investment.	
		Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Arizona:					
Salt River		$649,000.00	$14,042,000.00	$18,834.14	$10,450,109.23
Yuma	83	581,676.45	7,771,966.45	382,128.68	6,755,577.43
Colorado River	83		36,279.30		36,279.30
Colorado River Basin	83	28,415.05	90,665.05	28,010.40	75,011.35
Little Colorado			9,554.33		9,554.33
San Carlos			24,829.51		24,829.51
San Pedro			2,427.34		2,427.34
Arizona Cooperative		3,500.00	3,500.00		
Preliminary investigations			39,578.78		39,578.78
Total		1,262,591.50	22,020,800.76	428,973.22	17,393,367.27
California:					
Yuma	17	119,138.55	1,591,848.55	78,267.32	1,383,672.49
Orland		71,345.00	1,026,345.00	81,515.52	869,476.54
Klamath	25	54,998.03	774,998.03	23,018.10	619,754.85
Colorado River	17		7,430.70		7,430.70
Colorado River Basin	17	5,819.95	18,569.95	5,737.07	15,363.77
Iron Canyon		25.00	19,210.96	2.12	9,779.45
Pit River		55.00	2,555.00	90.25	2,489.18
Shasta County		942.00	3,442.00	2,100.54	2,140.99
Lassen County		308.00	5,308.00	684.45	1,945.60
Owens Valley			12,061.92		12,061.92
Sacramento Valley			43,620.72		43,620.72
San Joaquin			3,531.20		3,531.20
Preliminary investigations			7,952.48		7,952.48
Total		252,631.53	3,516,874.51	191,415.37	2,979,219.89
Colorado:					
Grand Valley		561,284.06	3,226,584.06	433,646.60	2,792,897.68
Uncompahgre		418,000.00	6,737,000.00	352,055.90	6,053,770.08
White River			4,357.00		4,357.00
Preliminary investigations			3,718.75		3,718.75
Total		979,284.06	9,971,659.81	785,702.50	8,854,743.51
Idaho:					
Boise		1,039,943.36	13,445,643.36	611,084.00	11,516,844.89
Minidoka		328,163.53	6,980,663.53	48,128.98	5,034,340.80
Dubois			17,228.91		17,228.91
Port Neuf			2,168.01		2,168.01
General investigations			4,000.00		1,191.78
King Hill			114.69	350.75	465.44
Total		1,368,106.89	20,449,818.50	659,563.73	16,572,239.83
Kansas: Garden City		1,592.77	397,592.77	55.52	376,240.79
Montana:					
Huntley		154,000.00	1,941,000.00	109,711.09	1,272,565.72
Milk River		422,540.00	3,055,540.00	289,447.11	2,664,279.55
Milk River, St. Mary storage		473,852.29	2,409,852.29	594,712.58	2,102,093.82
Sun River		720,000.44	3,471,000.44	723,074.13	2,971,455.47
Lower Yellowstone	70	32,846.60	2,432,992.67	8,869.57	2,251,376.31
Clark Fork			5,581.23		5,581.23
Crow Reservation			18,911.96		18,911.96
Lake Basin			7,103.26		7,103.26
Madison River			10,729.09		10,729.09
Marias		100.00	13,559.01	79.59	13,538.60
Total		1,803,339.33	13,366,269.95	1,725,894.07	11,317,635.01

TABLE 2.—*Statement of project allotments and net investments, by States, to June 30, 1916*—Continued.

State and project.	Per cent chargeable to State.	Allotments.		Net investment.	
		Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Nebraska:					
North Platte	70	$641,398.86	$5,913,798.86	$189,738.43	$4,791,634.78
Investigations			10,000.00		3,381.70
South Platte			2,877.01		2,877.01
Total		641,398.86	5,926,675.87	189,738.43	4,797,893.49
Nevada:					
Truckee-Carson		190,069.11	6,660,069.11	[1]1,303.15	5,773,132.07
Walker River			12,503.63	292.30	13,696.37
Walker River investigations		50.00	4,050.00		
Total		190,119.11	6,676,622.74	[1]1,010.85	5,786,828.44
New Mexico:					
Carlsbad		102,379.66	1,281,379.66	72,527.77	955,417.14
Hondo		4,038.77	405,038.77	2,633.15	369,890.26
Rio Grande	60	242,742.08	1,254,942.08	195,178.53	975,331.38
Rio Grande, Elephant Butte storage	60	364,432.70	2,788,432.70	300,077.65	2,327,625.85
La Plata			28,064.33		28,064.33
Las Vegas			5,014.09		5,014.09
Urton Lake			17,464.70		17,464.70
Preliminary investigations			2,738.91		2,738.91
Total		713,593.21	5,783,075.24	570,417.10	4,681,546.66
North Dakota:					
North Dakota pumping		20,034.99	1,249,034.99	[1]7,320.51	947,540.08
Lower Yellowstone	30	14,077.11	1,042,711.14	3,801.24	964,875.56
Bismarck			13,621.69		13,621.69
Little Missouri			11,933.52		11,933.52
Nesson			17,471.83		17,471.83
Washburn		1.20	10,532.73	1.20	10,532.73
Bowman			3,236.64	[1]287.90	2,948.74
Preliminary investigations			4,961.03		4,961.03
Total		34,113.30	2,353,503.57	[1]3,805.97	1,973,885.18
Oklahoma:					
Lawton		40,022.28	97,022.28	902.21	9,889.40
Cimarron			8,891.17		8,891.17
Red River			60,209.27		60,209.27
Investigations			400.00		400.00
Turkey Creek		1,000.00	1,000.00		
Total		41,022.28	167,522.72	902.21	79,389.84
Oregon:					
Umatilla		294,751.94	2,598,751.94	266,133.11	2,053,051.30
Klamath	75	164,994.08	2,324,994.08	69,054.30	1,859,264.54
Central Oregon			40,346.41		40,346.41
Columbia River		25.00	20,037.47		16,482.01
Malheur			83,490.62		83,490.62
Oregon Cooperative		7,500.00	60,761.49	8,850.20	49,271.26
Preliminary investigations			943.79		943.79
Total		467,271.02	5,129,325.80	344,037.61	4,102,849.93
South Dakota:					
Belle Fourche		143,949.27	3,856,722.96	54,696.88	3.367,580.72
Preliminary investigations			16,818.04		16,818.04
Total		143,949.27	3,873,541.00	54,696.88	3,384,398.76

[1] Credit.

TABLE 2.—*Statement of project allotments and net investments, by States, to June 30, 1916*—Continued.

State and project.	Per cent chargeable to State.	Allotments.		Net investment.	
		Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Texas:					
Rio Grande	40	$161,828.06	$836,628.06	$130,119.02	$650,220.92
Rio Grande, Elephant Butte storage	40	242,955.14	1,858,955.14	200,051.77	1,551,750.57
Pecos River	....	900.00	8,900.00	1,211.94	7,115.47
Total	....	405,683.20	2,704,483.20	331,382.73	2,209,086.96
Utah:					
Strawberry Valley	....	432,300.00	3,620,300.00	453,100.34	3,042,611.56
Bear Lake	....	....	18,827.72	....	18,827.72
Utah Lake	....	....	34,049.30	....	34,049.30
Provo-Webber	....	....	141.35	....	141.35
Total	....	432,300.00	3,673,318.37	453,100.34	3,095,629.93
Washington:					
Okanogan	....	51,000.00	956,000.00	42,247.15	758,319.16
Yakima storage	....	559,731.38	2,641,731.38	214,206.18	1,942,653.44
Yakima, Sunnyside	....	453,640.00	4,067,640.00	176,476.63	2,291,224.41
Yakima, Tieton	....	51,959.08	3,755,164.51	[1] 24,260.38	2,898,976.88
Benton	....	....	11,105.05	[1] 31.20	11,073.85
Kittitas	....	....	19,366.90	....	19,366.90
Wapato	....	....	36,465.77	....	36,465.77
Palouse	....	....	76,393.01	....	76,393.01
Palouse Cooperative	....	....	12,956.56	19.25	10,067.12
Priest Rapids	....	....	6,216.01	....	6,216.01
Preliminary investigations	....	....	3,776.95	....	3,776.95
Total	....	1,116,330.46	11,586,816.14	408,657.63	8,054,533.50
Wyoming:					
North Platte	30	274,885.23	2,534,485.23	81,316.47	2,053,557.77
Shoshone	....	419,299.69	5,206,299.69	212,490.13	4,300,957.14
De Smet	....	....	8,917.38	....	8,917.38
Wyoming Cooperative	....	2,500.00	2,500.00	2,345.66	2,345.66
Pathfinder Pumping	....	2,360.00	2,360.00	1,554.96	1,554.96
Total	....	699,044.92	7,754,562.30	297,707.22	6,367,332.91
Secondary projects	....	....	154,072.89	....	....
General accounts	....	178,715.07	7,176,548.42	[1] 1,685.59	124,634.17
Total	....	178,715.07	7,330,621.31	....	124,634.17
Grand total	....	10,731,086.78	132,683,084.56	6,435,742.15	102,151,456.07

[1] Credit.

RECEIPTS FROM SALES OF PUBLIC LANDS.

During the fiscal year 1915 the General Land Office collected from the sales of public lands, not including town-site sales, a total of $3,719,754.90, which resulted in the addition to the fund of $3,268,057.73. The amount added to the fund was 87.856 per cent of the amount collected. During the fiscal year 1916 the gross receipts were approximately $3,182,389.27. Of this amount, $1,334,162.31 has been credited to the reclamation fund, and it is estimated that there is a balance of $1,700,000, which will be available before the end of the calendar year.

The following table shows the gross receipts from the sale of public lands and the corresponding accruals to the reclamation fund by fiscal years since the passage of the reclamation law:

TABLE 3.—*Total receipts from the sale of public lands and resulting accruals to the reclamation fund.*

Fiscal year.	Total receipts from sale of public lands in reclamation States (not including town-site sales).	Accruals to the reclamation fund.	
		Amount (not including town-site sales).	Per cent of total receipts.
1901 to 1914, inclusive	$92,891,887.59	$84,362,211.57	90.817
1915	3,719,754.90	3,268,057.73	87.856
1916	3,182,389.27	[1] 3,034,162.31	95.342
Total	99,794,031.76	90,664,431.61	90.851

[1] Actual accruals to Dec. 31, 1915, $1,334,162.31; balance estimated.

ALLOTMENTS BY PROJECTS.

When funds become available, annual allotments are made in pursuance of which work is carried on. Table No. 4 gives a statement of the allotments from 1902 to June 30, 1916.

TABLE 4.—*Allotments for primary and secondary projects and general expenses to June 30, 1916.*

State and project.	Per cent chargeable to State.	Fiscal years 1902–1915.	Additional allotments during fiscal year 1916.	Total allotments to June 30, 1916.	Analysis of allotments.	
					Reclamation fund.	Bond loan.
Arizona: Salt River		$13,393,000.00	$649,000.00	$14,042,000.00	$13,547,000.00	$495,000.00
Arizona-California: Yuma	83–17	8,663,000.00	700,815.00	9,363,815.00	8,163,815.00	1,200,000.00
California: Orland		955,000.00	71,345.00	1,026,345.00	1,026,345.00	
Colorado:						
Grand Valley		2,665,300.00	561,284.06	3,226,584.06	2,226,584.06	1,000,000.00
Uncompahgre		6,319,000.00	418,000.00	6,737,000.00	5,237,000.00	1,500,000.00
Idaho:						
Boise		12,405,700.00	1,039,943.36	13,445,643.36	11,445,643.36	2,000,000.00
Minidoka		6,652,500.00	328,163.53	6,980,663.53	6,980,663.53	
Kansas: Garden City		396,000.00	1,592.77	397,592.77	397,592.77	
Montana:						
Huntley		1,787,000.00	154,000.00	1,941,000.00	1,941,000.00	
Milk River		4,569,000.00	806,392.29	5,465,392.29	4,465,392.29	1,000,000.00
Sun River		2,751,000.00	720,000.44	3,471,000.44	3,471,000.44	
Montana-North Dakota: Lower Yellowstone	70–30	3,428,780.10	46,923.71	3,475,703.81	3,475,703.81	
Nebraska-Wyoming: North Platte	70–30	7,532,000.00	916,284.09	8,448,284.09	6,448,284.09	2,000,000.00
Nevada: Truckee-Carson		6,470,000.00	190,069.11	6,660,069.11	5,467,069.11	1,193,000.00
Mexico:						
nd		1,179,000.00	102,379.66	1,281,379.66	1,281,379.66	
		401,000.00	4,038.77	405,038.77	405,038.77	
Rio Grande	60–40	5,727,000.00	1,011,957.98	6,738,957.98	2,238,957.98	4,500,000.00
ta pumping		1,229,000.00	20,034.99	1,249,034.99	1,249,034.99	
		57,000.00	40,022.28	97,022.28	97,022.28	
		2,304,000.00	294,751.94	2,598,751.94	2,273,751.94	325,000.00
	75–25	2,880,000.00	219,992.11	3,099,992.11	2,499,992.11	600,000.00
		3,712,773.69	143,949.27	3,856,722.96	3,856,722.96	
		3,188,000.00	432,300.00	3,620,300.00	1,348,300.00	2,272,000.00
		905,000.00	51,000.00	956,000.00	956,000.00	
		9,399,205.43	1,065,330.46	10,464,535.89	8,549,535.89	1,915,000.00
		4,787,000.00	419,299.69	5,206,299.69	5,206,299.69	
		1,117,416.48	53,501.20	1,170,917.68	1,170,917.68	
		80,488.73		80,488.73	80,488.73	
		6,997,833.35	178,715.07	7,176,548.42	7,176,548.42	
		78	10,731,086.78	132,683,084.56	112,683,084.56	20,000,000.00

RECONCILING ADMINISTRATIVE ACCOUNTS WITH TREASURY DEPARTMENT BALANCES AND STATEMENTS.

The accounts of the Treasury Department are limited to the movement of cash, either by withdrawal or deposit to the appropriations involved. The administrative accounts of the Reclamation Service, as entered in the tables herein, show the amount, both for receipts and disbursements, upon an accrual basis. The cash account, however, must, if correct, agree with the Treasury Department statement of funds made available by appropriations, reimbursements, expenditures, and withdrawals. Table 5, below, shows a condensed statement of cash collected, appropriated, disbursed, and on hand, and Table 6 gives a reconciliation of the amounts of the appropriations, withdrawals, and balances used in the preparation of these financial tables, with the figures shown by the statements of the Treasury Department.

TABLE 5.—*Reclamation fund account to June 30, 1916.*

Item.		Debit.	Credit.
Balance end of fiscal year, as per fourteenth annual report, p. 462			$86,195,217.30
Receipts during fiscal year 1916:			
Appropriation warrant—			
No. 20, Sept. 30, 1915	$6,435.63		
No. 23, Oct. 15, 1915	383,387.61		
No. 26, Nov. 3, 1915	298,036.48		
No. 34, Dec. 31, 1915	3,171.96		
No. 39, Jan. 18, 1916	1,034,351.85		
No. 48, Mar. 31, 1916	5,049.35		
No. 54, Apr. 24, 1916	662,460.83		
No. 60, June 10, 1916	671,701.48		
No. 64, June 30, 1916	6,532.34		
			3,071,127.53
Special reclamation fund, reimbursable, act of June 25, 1910 (36 Stat., 835)—			
Balance end of fiscal year 1915, as per fourteenth annual report, Table No. 5			12,000,000.00
No. 14, Aug. 23, 1915	500,000.00		
No. 16, Sept. 2, 1915	1,000,000.00		
No. 26, Nov. 8, 1915	500,000.00		
No. 32, Dec. 18, 1915	500,000.00		
No. 38, Jan. 14, 1916	500,000.00		
No. 58, June 7, 1916	500,000.00		
			3,500,000.00
Total			104,766,344.83
Disbursements, 379,907 vouchers, as per Table 7		$119,901,640.72	
Collections, 122,371 vouchers, as per Table 8			17,750,184.65
Balance with Treasurer United States, as per Table 6		1,710,477.00	
Balance with special fiscal agents		602,498.54	
Town site appropriations credited to projects		301,913.22	
Total		122,516,529.48	122,516,529.48

Table 6.—*Balances of reclamation fund with the Treasurer of the United States, June 30, 1916.*

Item.	Appropriation.	Withdrawals.	Balances.
Total and balance end of fiscal year 1915, as per fourteenth annual report, p. 462, Table 5	$98,195,217.30	$97,155,638.63	$1,039,578.67
Reclamation fund	3,071,127.53	5,891,614.71	679,512.82
Special reclamation fund, reimbursable, act of June 25, 1910 (36 Stat., 835)	3,500,000.00		
Total and balance as per statement of the Treasury Department	104,766,344.83	103,047,253.34	1,719,091.49
For items in Reclamation Service accounts, but not included in above add withdrawals on direct settlements by auditor $14,519.40 Deduct repayments on direct settlements 5,904.91		8,614.49	8,614.49
Total	104,766,344.83	103,055,867.83	1,710,477.00

Table 7.—*Disbursement vouchers paid to June 30, 1916.*

Fiscal year.	Quarter ended—	Number of vouchers.	Amount.
Balance from fourteenth annual report		351,136	$111,095,700.51
1916	Sept. 30, 1915	7,816	2,771,390.90
	Dec. 31, 1915	7,459	2,244,476.01
	Mar. 31, 1916	6,887	1,830,542.49
	June 30, 1916	6,609	1,959,530.81
Total to June 30, 1916		379,907	119,901,640.72

Table 8.—*Collection vouchers collected to June 30, 1916.*

Fiscal year.	Quarter ended—	Number of vouchers.	Amount.
Balance from fourteenth annual report		104,884	$15,379,976.59
1916	Sept. 30, 1915	1,010	498,612.91
	Dec. 31, 1915	1,308	471,735.11
	Mar. 31, 1916	5,406	749,759.16
	June 30, 1916	9,763	650,099.88
Total to June 30, 1916		122,371	17,750,184.65

Table 9.—*Transfer vouchers approved to June 30, 1916.*

Fiscal year.	Quarter ended—	Number of vouchers.	Amount.
Balance from fourteenth annual report		8,337	$5,006,759.37
1916	Sept. 30, 1915	167	71,794.31
	Dec. 31, 1915	193	48,580.69
	Mar. 31, 1916	253	172,285.73
	June 30, 1916	617	262,501.85
Total to June 30, 1916		9,567	5,552,221.95

INVESTMENT OF THE UNITED STATES IN PROJECTS.

Below is given a statement showing cash disbursed and received on account of the several projects and transfers between projects. The work of the service is grouped under four general heads, as follows: Primary projects, those for which specific appropriations of funds are in effect and on which construction is under way; secondary projects, those for which general appropriations of funds have been made for all such work as a whole and on which only preliminary studies and surveys have been made to determine their advisability and practicability; Indian irrigation projects; and general accounts, which represent those expenditures that are general in nature and are not directly chargeable to any project when first incurred, but which become a charge against all projects as a part of the general or overhead expenses of the service.

Table 10 gives the voucher transactions and net investments of the United States on the several primary projects to June 30, 1916; Table 11 gives the voucher transactions on secondary projects; and Table 12 gives the voucher transactions and net investment of the United States on Indian irrigation projects and miscellaneous to June 30, 1916.

TABLE 10.—*Voucher transactions and net investment of the United States on primary projects to June 30, 1916.*

State and project.	Debits.			
	Disbursement vouchers.		Transfers received.	
	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Arizona: Salt River	$475,213.95	$13,259,185.45	$32,919.67	$426,106.93
Arizona-California: Yuma	542,652.65	8,728,685.97	41,314.80	257,617.45
California: Orland	78,086.42	936,399.75	5,149.92	48,792.64
Colorado:				
Grand Valley	417,837.29	2,684,252.92	23,117.03	127,020.98
Uncompahgre	417,631.58	6,424,435.66	18,932.75	159,192.33
Idaho:				
Boise	744,717.52	11,944,138.32	51,355.27	432,406.06
Minidoka	234,151.19	6,104,975.13	16,170.36	308,833.62
Kansas: Garden City	5.75	380,066.31	109.77	11,844.58
Montana:				
Huntley	141,004.54	1,808,536.08	7,268.35	87,247.28
Milk River	281,317.07	2,597,575.61	15,503.12	139,993.34
St. Mary	572,734.94	1,996,935.89	25,284.45	211,335.78
Sun River	713,953.10	3,086,168.34	27,668.37	163,135.54
Montana-North Dakota: Lower Yellowstone	25,012.40	3,294,422.82	2,789.76	108,278.21
Nebraska-Wyoming: North Platte	427,196.61	7,451,850.57	28,703.12	214,962.00
Nevada: Truckee-Carson	88,054.27	6,165,013.01	9,256.07	285,621.81
New Mexico:				
Carlsbad	102,234.18	1,231,671.73	10,378.03	43,892.34
Hondo	3,310.08	390,328.61	446.89	14,276.58
New Mexico-Texas:				
Rio Grande	337,676.68	1,739,464.59	22,653.92	95,319.06
Elephant Butte	532,669.25	3,969,835.56	26,318.99	231,945.21
North Dakota: North Dakota pumping	18,149.01	1,039,594.62	2,278.13	197,881.71
Oklahoma: Lawton	959.26	8,575.57	251.65	1,637.53
Oregon: Umatilla	286,092.54	2,432,764.33	12,237.16	78,469.22
Oregon-California: Klamath	131,444.93	2,914,117.19	8,643.57	85,853.89
South Dakota: Belle Fourche	112,435.71	3,699,551.28	6,831.42	97,937.61
Utah: Strawberry Valley	506,489.43	3,190,892.12	17,852.81	119,916.22
Washington:				
Okanogan	50,058.27	880,215.82	4,199.84	37,921.31
Yakima storage	314,122.51	2,053,245.36	19,714.25	201,571.86
Yakima-Sunnyside	280,460.75	3,658,061.20	19,369.06	40,752.59
Yakima-Tieton	41,531.04	3,260,069.24	4,698.33	464,700.11
Wyoming: Shoshone	264,747.25	4,755,600.97	21,071.91	182,818.88
Total	8,141,950.17	112,086,639.02	483,483.79	4,871,783.27

Table 10.—*Voucher transactions and net investment of the United States on primary projects to June 30, 1916*—Continued.

State and project.	Credits.					
	Collection vouchers.					
	Water-right charges.				Miscellaneous.	
	Construction.		Operation and maintenance.		Fiscal year 1916.	To June 30, 1916.
	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.		
Arizona: Salt River		$100,000.00			$488,188.41	$3,070,691.15
Arizona-California: Yuma	$54,883.57	270,785.26	$16,744.78	$61,090.33	50,503.00	420,515.88
California: Orland					1,565.05	110,572.48
Colorado:						
Grand Valley					6,959.99	14,335.03
Uncompahgre					82,743.07	496,579.60
Idaho:						
Boise					169,766.04	737,024.74
Minidoka	43,326.17	441,782.68	51,250.02	310,459.62	94,775.19	403,742.54
Kansas: Garden City		142.50		104.50		4,560.67
Montana:						
Huntley	14,491.20	270,173.02	19,757.48	115,513.70	4,313.12	77,044.47
Milk River					4,967.58	37,640.63
St. Mary					2,710.96	51,118.26
Sun River	[1]7,481.59	102,685.86	5,556.28	42,407.44	17,987.69	63,684.28
Montana-North Dakota: Lower Yellowstone	924.18	35,872.20	649.48	36,793.97	13,094.61	67,473.11
Nebraska-Wyoming: North Platte	115,478.26	352,599.87	56,833.54	330,976.03	12,073.79	110,342.19
Nevada: Truckee-Carson	32,432.09	296,767.26	34,291.79	191,944.93	30,575.97	138,742.60
New Mexico:						
Carlsbad	21,038.78	140,368.89	15,482.02	139,816.79	8,439.60	26,250.59
Hondo					1,088.57	33,838.16
New Mexico-Texas:						
Rio Grande					30,330.26	171,996.43
Elephant Butte					36,532.04	248,913.41
North Dakota: North Dakota pumping	210.53	8,058.05		13,307.15	27,298.77	85,383.51
Oklahoma: Lawton					.20	.20
Oregon: Umatilla	10,226.97	206,338.23	10,105.44	75,202.05	10,495.88	82,258.48
Oregon-California: Klamath	13,376.98	291,082.86	26,503.71	137,127.96	9,007.69	61,121.16
South Dakota: Belle Fourche	34,456.18	168,078.68	24,611.89	131,448.95	5,224.18	92,442.19
Utah: Strawberry Valley	19,827.87	19,827.87	5,129.23	5,129.23	41,493.74	192,796.35
Washington:						
Okanogan	73.22	24,622.55	802.27	36,294.89	11,035.07	88,495.62
Yakima storage	100,000.00	200,000.00			14,169.89	76,815.63
Yakima-Sunnyside	45,891.88	679,422.79	65,377.53	542,674.41	8,862.48	108,035.52
Yakima-Tieton	43,908.30	269,388.61	24,940.76	149,880.44	2,348.06	78,138.53
Wyoming: Shoshone	28,104.41	268,633.67	22,803.80	127,923.00	22,351.54	188,714.12
Total	571,161.45	4,146,680.35	380,840.02	2,448,095.19	1,208,852.44	7,339,262.58

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[1] Adjustment of credits.

Table 10.—*Voucher transactions and net investment of the United States on primary projects to June 30, 1916*—Continued.

State and project.	Credits.		Net investment of the United States.	
	Transfers issued.			
	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Arizona: Salt River	$1,111.07	$64,492.00	$18,834.14	$10,450,109.23
Arizona-California: Yuma	1,440.10	94,662.03	460,396.00	8,139,249.92
California: Orland	155.77	5,143.37	81,515.52	869,476.54
Colorado:				
Grand Valley	347.73	4,041.19	433,646.60	2,792,897.68
Uncompahgre	1,765.36	33,278.31	352,055.90	6,053,770.08
Idaho:				
Boise	15,222.75	122,674.75	611,084.00	11,516,844.89
Minidoka	12,841.19	223,483.11	48,128.98	5,034,340.80
Kansas: Garden City	60.00	10,862.43	55.52	376,240.79
Montana:				
Huntley	....	160,486.45	109,711.09	1,272,565.72
Milk River	2,405.50	35,648.77	289,447.11	2,664,279.55
St. Mary	595.85	55,064.59	594,712.58	2,102,093.82
Sun River	2,484.96	69,071.33	723,074.13	2,971,455.47
Montana-North Dakota: Lower Yellowstone	463.13	41,809.88	12,670.81	3,216,251.87
Nebraska-Wyoming: North Platte	459.24	27,710.93	271,054.90	6,845,192.55
Nevada: Truckee-Carson	1,313.64	50,047.96	[1] 1,303.15	5,773,132.07
New Mexico:				
Carlsbad	131.04	13,710.96	72,537.77	955,417.14
Hondo	85.26	876.77	2,633.15	369,890.26
New Mexico-Texas:				
Rio Grande	4,702.79	37,235.52	325,297.55	1,625,552.30
Elephant Butte	22,326.78	73,490.94	500,129.42	3,879,376.42
North Dakota: North Dakota pumping	238.35	183,187.54	[1] 7,320.51	947,540.08
Oklahoma: Lawton	308.50	323.50	902.21	9,889.40
Oregon: Umatilla	1,369.30	94,883.49	266,133.11	2,053,051.30
Oregon-California: Klamath	127.72	31,619.71	92,072.40	2,479,019.39
South Dakota: Belle Fourche	278.00	37,938.35	54,696.88	3,367,580.72
Utah: Strawberry Valley	4,791.06	50,443.33	453,100.34	3,042,611.56
Washington:				
Okanogan	100.40	10,404.91	42,247.15	758,319.16
Yakima storage	5,460.69	35,348.15	214,206.18	1,942,653.44
Yakima-Sunnyside	3,221.81	77,456.66	176,476.63	2,291,224.41
Yakima-Tieton	[2] 702.87	328,384.89	[1] 24,260.38	2,898,976.88
Wyoming: Shoshone	69.28	51,691.92	212,490.13	4,300,957.14
Total	83,173.89	2,024,478.74	6,386,416.16	100,999,960.58

[1] Receipts exceed expenditures.

[2] Adjustment of credits.

TABLE 11.—*Voucher transactions and net investments of the United States on secondary projects to June 30, 1916.*

State and project.	Debits.			
	Disbursement vouchers.		Transfers received.	
	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Arizona:				
Little Colorado		$9,515.33		$40.00
San Carlos		24,589.74		252.67
San Pedro		2,423.72		3.97
Arizona-California:				
Colorado River		42,235.20		7,160.38
Colorado River Basin	$30,986.67	81,825.55	$2,958.75	10,306.84
California:				
Owens Valley		26,048.91		30.00
Sacramento Valley		52,808.13		2,748.07
San Joaquin		3,513.92		17.48
Iron Canyon Cooperative	3.12	15,167.54		4,198.30
Pitt River Cooperative	90.25	2,248.17		241.01
Shasta County Cooperative	2,266.46	4,402.03	184.08	188.96
Lassen County Cooperative	684.45	2,398.88		46.72
Colorado: White River		4,348.04		9.11
Idaho:				
Dubois		21,464.03		834.98
Port Neuf		2,165.77		2.24
General investigations		496.55		695.23
King Hill	88.95	203.64	261.80	261.80
Montana:				
Clark Fork		5,417.71		433.67
Crow Reservation		21,029.47		5.01
Lake Basin		7,044.39		79.87
Madison River		10,795.45		2.57
Marias	63.00	14,062.46	16.59	109.89
Nebraska:				
South Platte		1,913.96		963.05
Nebraska investigations		3,350.94		42.76
Pathfinder Pumping	1,554.96	1,554.96		
Nevada: Walker River	292.30	13,643.22		53.15
New Mexico:				
La Plata		29,598.20		168.55
Las Vegas		5,012.16		2.23
Urton Lake		19,330.65		273.71
North Dakota:				
Bismarck		16,709.04		26.69
Little Missouri		11,665.59		1,709.00
Nesson		7,491.51		29,786.35
Washburn	1.20	9,951.90		1,973.89
Bowman		3,649.46		1,512.97
Oklahoma:				
Cimarron		8,725.96		321.76
Red River		59,413.75		1,902.64
Oklahoma reconnoissance		400.00		
Oregon:				
Malheur		82,592.87	18.00	4,312.28
Central Oregon		43,014.03	18.00	1,767.04
Columbia River Cooperative		14,469.55		7,010.18
Oregon Cooperative	9,949.54	46,328.73	1,056.79	11,401.75
Texas: Pecos River investigations	1,245.28	7,498.21	7.07	427.81
Utah:				
Bear Lake		18,859.06		30.72
Utah Lake		34,044.67		9.25
Provo-Weber		141.35		
Washington:				
Benton		11,167.45		
Kittitas		19,366.90		
Wapato		36,445.06		20.71
Palouse		76,789.20		130.19
Palouse Cooperative	19.25	9,394.00		3,029.68
Priest Rapids		6,218.98		247.58
Wyoming:				
De Smet		9,053.32		2.51
Wyoming Cooperative	2,369.16	2,369.16		
Total	49,614.59	964,368.47	4,521.08	94,795.22

TABLE 11.—*Voucher transactions and net investments of the United States on secondary projects to June 30, 1916*—Continued.

State and project.	Credits.				Net investment.	
	Collection vouchers.		Transfers issued.			
	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Arizona:						
Little Colorado		$1.00				$9,554.33
San Carlos		12.90				24,829.51
San Pedro		.35				2,427.34
Arizona-California:						
Colorado River		760.32		$4,925.26		43,710.00
Colorado River Basin	$137.95	231.87	$60.00	1,525.40	$33,747.47	90,375.12
California:						
Owens Valley		14,016.99				12,061.92
Sacramento Valley		91.79		11,843.69		43,620.72
San Joaquin		.20				3,531.20
Iron Canyon Cooperative	1.00	9,045.43		540.96	2.12	9,779.45
Pitt River Cooperative					90.25	2,489.18
Shasta County Cooperative	350.00	2,450.00			2,100.54	2,140.99
Lassen County Cooperative		500.00			684.45	1,945.60
Colorado: White River		.15				4,357.00
Idaho:						
Dubois		1.81		5,068.29		17,228.91
Port Neuf						2,168.01
General investigations						1,191.78
King Hill					350.75	465.44
Montana:						
Clark Fork		.25		269.90		5,581.23
Crow Reservation		1.90		2,120.62		18,911.96
Lake Basin				21.00		7,103.26
Madison River		1.85		67.08		10,729.09
Marias		1.55		632.20	79.59	13,538.60
Nebraska:						
South Platte						2,877.01
Nebraska investigations				12.00		3,381.70
Pathfinder Pumping					1,554.96	1,554.96
Nevada: Walker River					292.30	13,696.37
New Mexico:						
La Plata		1,702.42				28,064.33
Las Vegas		.30				5,014.09
Urton Lake		1,225.51		914.15		17,464.70
North Dakota:						
Bismarck		14.70		3,099.34		13,621.69
Little Missouri		1.25		1,439.82		11,933.52
Nesson		4.14		19,801.89		17,471.83
Washburn		42.38		1,350.68	1.20	10,532.73
Bowman	287.90	1,122.60		1,091.09	[1] 287.90	2,948.74
Oklahoma:						
Cimarron				156.55		8,891.17
Red River		161.77		945.35		60,209.27
Oklahoma reconnoissance						400.00
Oregon:						
Malheur		279.80	18.00	3,134.73		83,490.62
Central Oregon		1,353.58	18.00	3,081.08		40,346.41
Columbia River Cooperative		218.12		4,779.60		16,482.01
Oregon Cooperative	702.18	865.73	1,453.95	7,593.49	8,850.20	49,271.26
Texas: Pecos River investigations	25.02	28.55	15.39	782.00	1,211.94	7,115.47
Utah:						
Bear Lake		62.06				18,827.72
Utah Lake		4.62				34,049.30
Provo-Weber						141.35
Washington:						
Benton	31.20	93.60			[1] 31.20	11,073.85
Kittitas						19,366.90
Wapato						36,465.77
Palouse		126.38		400.00		76,393.01
Palouse Cooperative		24.77		2,331.79	19.25	10,067.12
Priest Rapids		250.55				6,216.01
Wyoming:						
De Smet		39.55		98.90		8,917.38
Wyoming Cooperative	23.50	23.50			2,345.66	2,345.66
Total	1,558.75	34,764.24	1,565.34	78,026.86	51,011.58	946,372.59

[1] Credit.

TABLE 12.—*Voucher transactions and net investment of the United States on Indian irrigation and miscellaneous to June 30, 1916.*

Item.	Debits.			
	Disbursement vouchers.		Transfers received.	
	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Indian irrigation:				
Blackfeet project	$1,432.74	$925,426.30	$108.48	$109,379.18
Flathead project	14,439.86	1,528,700.89	973.14	85,547.50
Fort Peck project	1,667.01	439,109.12	161.79	40,897.01
Total	17,539.61	2,893,236.31	1,243.41	235,823.69
Miscellaneous:				
General expense	450,503.48	3,268,741.45	48,551.39	167,822.66
Preliminary investigations				80,488.73
Jackson Lake enlargement	146,332.36	688,655.47	7,662.91	101,508.38
Total	596,835.84	3,957,396.92	56,214.30	349,819.77

Item.	Credits.				Net investment.	
	Collection vouchers.		Transfers issued.			
	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Indian irrigation:						
Blackfeet project	$146.53	$950,909.15	$951.00	$84,440.49	$443.69	[1] $544.16
Flathead project	22,121.09	1,566,459.20	84.55	46,594.33	[1] 6,792.64	1,194.86
Fort Peck project	162.19	463,720.62		16,188.60	1,666.61	96.91
Total	22,429.81	2,981,088.97	1,035.55	147,223.42	[1] 4,682.34	747.61
Miscellaneous:						
General expense	16,538.14	47,403.72	459,583.43	3,300,128.76	22,933.30	89,031.63
Preliminary investigations						80,488.73
Jackson Lake enlargement	173,827.45	752,939.75	104.37	2,369.17	[1] 19,936.55	34,854.93
Total	190,365.59	800,343.47	459,687.80	3,302,497.93	2,996.75	204,375.29

[1] Credit balances due to transfer of appropriation in advance of performing work.

A recapitulation of Tables 10, 11, and 12 follows:

TABLE 13.—*Recapitulation and verification of voucher transactions and all net investments of the United States from the reclamation fund to June 30, 1916.*

Item.	Debits.			
	Disbursement vouchers.		Transfers received.	
	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Primary projects	$8,141,950.17	$112,086,639.02	$483,483.79	$4,871,783.27
Secondary projects	49,614.59	964,368.47	4,521.08	94,795.22
Indian irrigation	17,539.61	2,893,236.31	1,243.41	235,823.69
Miscellaneous	596,835.84	3,957,396.92	56,214.30	349,819.77
Total	8,805,940.21	119,901,640.72	545,462.58	5,552,221.95

TABLE 13.—*Recapitulation and verification of voucher transactions and all net investments of the United States from the reclamation fund to June 30, 1916*—Continued.

Item.	Credits.			
	Collection vouchers.			
	Miscellaneous.		Water-right charges.	
	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Primary projects	$1,203,852.44	$7,339,262.53	$952,001.47	$6,594,725.74
Secondary projects	1,558.75	34,764.24		
Indian irrigation	22,429.81	2,981,088.97		
Miscellaneous	190,365.59	800,343.47		
Total	1,418,206.59	11,155,459.21	952,001.47	6,594,725.74

Item.	Credits.		Net investment.	
	Transfers issued.			
	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Primary projects	$83,173.89	$2,024,473.74	$6,386,416.16	[1]$100,999,960.58
Secondary projects	1,565.34	78,026.86	51,011.58	946,372.59
Indian irrigation	1,035.55	147,223.42	[1] 4,682.34	747.61
Miscellaneous	459,687.80	3,302,497.93	2,996.75	204,375.29
Total	545,462.58	5,552,221.95	6,435,742.15	102,151,456.07

[1] Credit balances due to transfer of appropriation in advance of performing work.

COLLECTIONS.

The two tables below give information as to collections that have been made under the reclamation operations. Table 14 gives an analysis of the sources of all cash collections to June 30, 1916, while Table 15 gives, by projects, the amount collected for water-right charges.

TABLE 14.—*Analysis of cash collections to June 30, 1916.*

Sources.	Fiscal years 1903–1915.	Fiscal year 1916.	Total to June 30, 1916.
Miscellaneous sales	$1,726,614.32	$207,226.29	$1,933,840.61
Miscellaneous services	4,137,797.46	290,203.34	4,428,000.80
Temporary water rentals	2,707,529.08	622,790.81	3,330,319.89
Power and light	759,718.46	280,806.11	1,040,524.57
Transportation refunds	291,680.45	13,421.82	305,102.27
Forfeitures by bidders and contractors	78,688.71	220.00	78,908.71
Water-right construction charges	3,575,468.90	571,161.45	4,146,630.35
Water-right operation and maintenance charges	2,067,255.07	380,840.02	2,448,095.09
Over disbursements	35,224.14	3,538.22	38,762.36
Total	15,379,976.59	2,370,208.06	17,750,184.65

TABLE 15.—*Collection of water-right charges by projects to June 30, 1916.*

State and project.	Construction charges.		Operation and maintenance charges.		Total.	
	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.
Arizona: Salt River		$100,000.00				$100,000.00
Arizona-California: Yuma	$54,883.57	270,785.26	$16,744.78	$61,090.33	$71,628.35	331,875.59
Idaho: Minidoka	43,326.17	441,782.68	51,250.02	310,459.62	94,576.19	752,242.30
Kansas: Garden City		142.50		104.50		247.00
Montana:						
Huntley	14,491.20	270,173.02	19,757.48	115,513.70	34,248.68	385,686.72
Sun River	[1] 7,481.59	102,685.36	5,556.28	42,407.44	[1] 1,925.31	145,092.80
Montana-North Dakota: Lower Yellowstone	924.13	35,872.20	649.48	36,793.97	1,573.61	72,666.17
Nebraska - Wyoming: North Platte	115,478.26	352,599.87	56,833.54	330,976.03	172,311.80	683,575.90
Nevada: Truckee-Carson	32,432.09	296,767.26	34,291.79	191,944.93	66,723.88	488,712.19
New Mexico: Carlsbad	20,822.42	140,154.53	15,482.21	139,816.68	36,304.63	279,971.21
North Dakota: North Dakota Pumping	210.53	8,058.05		13,307.15	210.53	21,365.20
Oregon: Umatilla	10,225.97	206,338.23	10,105.44	75,202.05	20,331.41	281,540.28
Oregon-California: Klamath	13,376.98	291,082.86	26,503.71	137,127.96	39,880.69	428,210.82
South Dakota: Belle Fourche	34,456.18	168,078.68	24,611.89	131,448.95	59,068.07	299,527.63
Utah: Strawberry Valley	19,827.87	19,827.87	5,129.23	5,129.23	24,957.10	24,957.10
Washington:						
Okanogan	73.22	24,622.55	802.27	36,294.89	875.49	60,917.44
Yakima storage	100,000.00	200,000.00			100,000.00	200,000.00
Sunnyside	45,891.88	679,422.79	65,377.53	542,674.41	111,269.41	1,222,097.20
Tieton	43,903.80	269,388.61	24,940.76	149,880.44	68,844.56	419,269.05
Wyoming: Shoshone	28,104.41	268,633.67	22,803.80	127,923.00	50,908.21	396,556.67
Total	571,161.45	4,146,630.35	380,840.02	2,448,095.19	952,001.47	6,594,725.74

State and project.	Refunds.						Net collection of water-right charges to June 30, 1916.
	Construction charges.		Operation and maintenance charges.		Total.		
	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.	Fiscal year 1916.	To June 30, 1916.	
Arizona: Salt River							$100,000.00
Arizona-California: Yuma							331,875.59
Idaho: Minidoka		$234.10		$18.00		$252.10	752,242.30
Kansas: Garden City		142.50		104.50		247.00	
Montana:							
Huntley		603.39		96.97		700.36	385,686.72
Sun River		755.85		125.97		881.82	145,092.80
Montana-North Dakota: Lower Yellowstone							72,666.17
Nebraska-Wyoming: North Platte	$187.12	416.72		24.40	$187.12	441.12	683,388.90
Nevada: Truckee-Carson		210.00		42.00		252.00	488,712.19
New Mexico: Carlsbad							280,185.38
North Dakota: North Dakota Pumping		129.20		23.80		153.00	21,365.20
Oregon: Umatilla		63.00		9.55		72.55	281,540.28
Oregon-California: Klamath		186.00		18.00		204.00	428,210.82
South Dakota: Belle Fourche		260.00		5.87		265.87	299,527.10
Washington:							
Okanogan				52.50		52.50	60,917.44
Yakima storage							200,000.00
Sunnyside		1,874.60		542.45		2,417.05	1,222,097.20
Tieton		762.60				762.60	419,269.03
Wyoming: Shoshone		1,187.52		257.02		1,444.54	396,556.67
Total	187.12	6,825.48		1,321.03	187.12	8,146.51	6,594,538.32

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[1] Adjustment of credits.

RIO GRANDE DAM APPROPRIATION.

The three tables that follow give for the Rio Grande Dam appropriation information similar to that appearing in Tables 5 to 8, inclusive, with corresponding titles for the reclamation fund:

TABLE 16.—*Special appropriation for Rio Grande (Engle) Dam (34 Stat., 1357) to June 30, 1916.*

	Debit.	Credit.
Appropriation warrant No. 79, Mar. 4, 1907		$1,000,000.00
Disbursements, 2,896 vouchers	$1,000,091.78	
Collections, 24 vouchers		91.78
Total	1,000,091.78	1,000,091.78

TABLE 17.—*Balances of appropriations for Rio Grande (Engle) Dam with Treasurer of the United States, June 30, 1907, to June 30, 1916.*

Fiscal year.	Appropriation.	Withdrawals.	Balances.
1907	$1,000,000.00		$1,000,000.00
1908		$33,113.21	966,886.79
1909		137,074.22	829,812.57
1910		247,217.23	582,595.34
1911		327,875.96	254,719.38
1912		214,052.49	40,666.89
1913		39,165.89	1,501.00
1914		1,501.00	
Total	1,000.000.00	1,000,000.00	

TABLE 18.—*Disbursement and collection vouchers, appropriation for Rio Grande (Engle) Dam, paid and collected to June 30, 1916.*

Fiscal year.	Disbursement vouchers.		Collection vouchers.	
	Number.	Amount.	Number.	Amount.
Balance from Twelfth Annual Report	2,895	$998,590.78	24	$91.78
June 30, 1915	1	1,501.00		
Total	2,896	1,000,091.78	24	91.78

RECLAMATION ORGANIZATION.

ADMINISTRATIVE ORGANIZATION OF THE SERVICE.

The following order was issued by the Secretary of the Interior on November 22, 1915:

Effective December 1, 1915, and until further orders, the following offices and organization shall be maintained for the administration of the United States Reclamation Service:

OFFICES.

1. *Washington, D. C., office.*—An office will be maintained in Washington as the headquarters of an organization to be known as the Reclamation Service, and to be composed of the director and chief engineer, as chairman, the chief counsel, and the comptroller. These officers shall determine matters of general policy and recommend appropriate action thereon to the Secretary of the Interior; but no action of the members individually or collectively shall become effective unless the same is in pursuance of authority previously given by the Secretary of the Interior.

2. *Denver, Colo., office.*—An executive office shall be maintained at Denver in charge of the chief of construction, who shall be appointed by the Secretary of the Interior on the recommendation of the director and chief engineer, and all matters relating to the management and execution of the work in the field shall pass through said office, except when in the opinion of the director and chief engineer an emergency or special conditions warrant a departure from this practice. Under the latter circumstances copies of all instructions shall be promptly forwarded to the Denver office for their information and files. Departments of purchasing and disbursing should be maintained in the Denver office.

3. *Project offices.*—Local offices will be maintained on each project, in charge of a project manager or engineer who shall control all of the employees engaged in the construction or operation of their respective projects and will be held strictly responsible for the economical and efficient administration of the project offices.

DIVISIONS.

4. *Executive and engineering.*—The director and chief engineer shall be the executive officer of the service and shall govern and control all employees engaged in investigating, constructing, operating, and maintaining projects. He shall issue all instructions required to carry out approved policies and for executing the necessary work, through the executive office at Denver. He shall control an administrative examination of all accounts in Washington.

He shall have power to sign any contracts and make any commitments authorized by the Secretary of the Interior and shall have control of all employees of the Washington office except the legal division and the comptroller.

The chief of construction shall represent the executive officer in the field and shall have charge of the Denver office and all employees engaged in the construction, operation, and maintenance of the projects and works incident thereto. He shall report to the director and chief engineer, and, subject to the latter's general approval, shall adopt the measures necessary to execute the approved plans and policies.

Project managers or engineers will report direct to the chief of construction at Denver, sending copies of regular monthly reports to the director.

Communications between the director and subordinate officers shall pass through the office of the chief of construction, except when in the opinion of the director and chief engineer emergencies or special conditions warrant a departure from the usual practice, in which case copies shall be promptly forwarded to the Denver office for their information and files.

5. *Legal division.*—The chief counsel, as the head of the the legal division, shall conduct all investigations involving the legal rights and privileges of the service, and will control all employees of his division. He will correspond direct with the district counsel in regard to legal affairs, but shall communicate with the executive department through the chief engineer and regular channels.

6. *Fiscal division.*—The comptroller shall be the head of the inspection division and shall conduct the inspection of all fiscal practices and accounts. For this purpose he shall organize and control an ample force of inspectors and accountants to insure

the thorough inspection of methods and practices and audit of the accounts kept in all offices of the service, and to collect and compile the information as to fiscal affairs required by the Secretary of the Interior and the service. The inspectors shall advise and direct the field offices as to routine methods of complying with approved regulations only and shall promptly report all irregularities to the comptroller, who will advise the director and chief engineer, and the latter shall rectify the matter through regular channels.

7. *Supervisor of irrigation.*—The supervisor of irrigation shall maintain an office at Billings, Mont., and shall advise and counsel with water users as to the best practice of irrigating and cultivating irrigated lands, the development of markets, and all questions affecting the welfare of settlers and water users. He shall consult and cooperate with the experts of the Agricultural Department that are assigned to the projects, and advise the executive officer of the Reclamation Service regarding all irregularities in the operating departments of the respective projects that may come to his notice through inspection or otherwise.

FRANKLIN K. LANE.

GENERAL OFFICERS.

Hon. Franklin Knight Lane, Secretary of the Interior.

Brig. Gen. William L. Marshall, United States Army, retired, consulting engineer to the Secretary.

The following three officials of the Reclamation Service constitute a board or commission for the purpose of considering all questions of administrative policy and management and recommending action thereon to the Secretary of the Interior:

Arthur Powell Davis, director and chief engineer, Washington, D. C.

Will R. King, chief counsel, Washington, D. C.

W. A. Ryan, comptroller, Washington, D. C.

WASHINGTON OFFICE.

Office of the director and chief engineer: C. J. Blanchard, statistician; Frank Teichman and E. C. Bebb, engineers; John H. Pellen, draftsman; F. L. Cavis, chief accountant; C. H. Fitch, chief clerk; Hugh A. Brown, editor, Reclamation Record; Emmet Carr, purchasing agent; A. H. Shellenberger, fiscal agent; H. T. Cowling, photographer.

Office of the chief counsel: Law section—E. B. Hoffman, E. S. Taylor, C. A. Mansuy, George A. Ward, R. M. Patrick, E. W. R. Ewing, and Ottamar Hamele; land and general section—Morris Bien (counsel), J. M. McKinney, O. G. Cowhick, D. H. Sibbett, J. J. Fuller, J. E. Golladay, and Mrs. E. W. Ballard.

Office of the comptroller: C. G. Smith, chief examiner of accounts; A. J. Hughes, examiner of accounts.

DENVER OFFICE.

F. E. Weymouth, chief of construction, Tramway Building, Denver, Colo.; R. F. Walter, senior engineer; J. M. Gaylord, electrical engineer; D. W. Murphy, engineer in charge of drainage; J. L. Savage, designing engineer; E. A. Moritz, office engineer; A. McD. Brooks, purchasing agent; C. G. Duganne, disbursing officer; J. Y. Jewett, cement expert, 424 Federal Building, Denver, Colo.; I. C. Harris, engineer in charge of inspection of materials, 802 Federal Building, Chicago. Ill.

OFFICE OF SUPERVISOR OF IRRIGATION.

I. D. O'Donnell, supervisor of irrigation, 206 State Bank Building, Billings, Mont.
Robert C. Elting, chief clerk.

FIELD OFFICES OF CHIEF COUNSEL.

Denver, Colo.—E. E. Roddis, district counsel in charge; Armand Offutt, district counsel in charge contracts; J. J. Buck, assistant district counsel. Colorado River water-right investigations: H. L. Holgate, assistant chief counsel in charge; H. D. Padgett, T. R. Alex, C. F. Carpenter, Don. R. Cather, and E. P. King, assistant district counsel.

El Paso, Tex.—P. W. Dent, district counsel; projects: Rio Grande, Carlsbad, and Hondo.

Los Angeles, Cal.—Oliver P. Morton, district counsel; D. G. Tyree, assistant district counsel. Projects: Salt River, Yuma, Orland, and Truckee-Carson.

Portland, Oreg.—E. H. Peery, district counsel. Projects: Umatilla and Klamath.

North Yakima, Wash.—E. W. Burr, district counsel. Projects: North Yakima and Okanogan.

Boise, Idaho.—B. E. Stoutemyer, district counsel. Projects: Boise, Minidoka, Jackson Lake Enlargement, and Strawberry Valley.

Helena, Mont.—W. J. Egleston, district counsel. W. W. Davis and R. J. Coffey, assistant district counsel. Projects: Blackfeet, Flathead, Fort Peck, Huntley, Milk River, St. Mary Storage, Sun River, North Dakota Pumping, Lower Yellowstone, and Shoshone.

Scottsbluff, Nebr.—A. R. Honnold, district counsel; Mrs. G. B. Mathiot, assistant district counsel. Projects: North Platte, Pathfinder Dam, and Belle Fourche.

Montrose, Colo.—J. R. Alexander, district counsel. Projects: Grand Valley and Uncompahgre Valley.

SOUTHERN DIVISION.

Salt River project.—W. S. Cone, project manager, Phoenix, Ariz.; A. J. Haltom, assistant engineer; L. J. Mead, chief clerk.

Yuma project.—L. M. Lawson, project manager, Yuma, Ariz.; R. M. Priest, superintendent of construction; R. S. Fessenden, irrigation manager; R. B. Smith, chief clerk.

Rio Grande project.—E. H. Baldwin, senior engineer, El Paso, Tex.; H. J. Gault, engineer; Oro McDermith, irrigation manager; J. M. Luney, chief clerk.

Elephant Butte dam.—L. J. Charles, construction engineer, Elephant Butte, N. Mex.; C. F. Carpenter, chief clerk.

Carlsbad and Hondo projects.—L. E. Foster, project manager, Carlsbad, N. Mex.; C. A. May, assistant project manager; V. L. Minter, chief clerk.

Lawton project.—C. T. Pease, project manager, Lawton, Okla.

PACIFIC DIVISION.

Boise project.—D. W. Cole, senior engineer, Boise, Idaho; E. R. Mills, chief clerk.

Minidoka project.—Barry Dibble, project manager, Rupert, Idaho; N. K. Jensen, chief clerk.

Jackson Lake enlargement project.—F. A. Banks, engineer, Moran, Wyo.; F. T. Crowe, engineer; S. R. Wilson, chief clerk.

Orland project.—A. N. Burch, project manager, Orland Cal.; C. H. Lillingston, chief clerk.

Truckee-Carson project.—F. G. Hough, project manager, Fallon, Nev.; J. R. Post, chief clerk.

Umatilla project.—H. D. Newell, project manager, Hermiston, Oreg.; Maurice Scroggs, superintendent of irrigation; C. W. Kellogg, chief clerk.

Klamath project.—J. G. Camp, project manager, Klamath Falls, Oreg.; C. C. Hogue, chief clerk.

Yakima project.—Storage unit: C. E. Crownover, project manager, Meadow Creek, Wash.; R. R. Ruhnke, chief clerk. Sunnyside and Tieton units: R. K. Tiffany, project manager, North Yakima, Wash.; R. K. Cunningham, chief clerk; J. G. Heinz, assistant manager, Sunnyside, Wash.; J. S. Moore, assistant engineer; C. F. Gleason, assistant engineer (pumping plant construction); G. C. Finley, superintendent of irrigation, Naches, Wash.

NORTHERN DIVISION.

Blackfeet project.—J. B. Bond, project manager, Browning, Mont.; Frank Nivens, chief clerk.

Flathead project.—E. F. Tabor, project manager, St. Ignatius, Mont.; C. J. Moody, superintendent of construction; Harry Caden, chief clerk.

Fort Peck project.—R. M. Conner, project manager, Poplar, Mont.; G. H. Murphy, chief clerk.

Huntley project.—R. H. Fifield, project manager, Huntley, Mont.; E. B. Le Claire, chief clerk.

Milk River project.—W. W. Schlecht, project manager, Malta, Mont.; G. E. Stratton, engineer, Glasgow, Mont.; E. R. Scheppelmann, chief clerk.

St. Mary storage unit.—J. B. Bond, project manager, Browning, Mont.; L. V. Branch, engineer, Sherburne, Mont.; Frank Nivens, chief clerk, Browning, Mont.

Sun River project.—C. P. Williams, senior engineer, Fort Shaw, Mont.; A. H. Ayers, engineer; C. A. Peavey, chief clerk.

North Dakota pumping project.—W. S. Arthur, acting project manager and chief clerk, Williston, N. Dak.

Lower Yellowstone project.—L. H. Mitchell, project manager, Savage, Mont.; C. H. Young, chief clerk.

Okanogan project.—Calvin Casteel, project manager, Okanogan, Wash.; H. A. Yates, chief clerk.

Shoshone project.—G. O. Sanford, project manager, Powell, Wyo.; C. M. Jump, superintendent of irrigation; C. E. Piatt, chief clerk.

CENTRAL DIVISION.

Grand Valley project.—J. H. Miner, project manager, Grand Junction, Colo.; A. L. Collins, chief clerk.

Uncompahgre Valley project.—F. D. Pyle, project manager, Montrose, Colo.; J. H. Fertig, assistant engineer; E. R. Furstenfeld, chief clerk.

North Platte project.—Andrew Weiss, project manager, Mitchell, Nebr.; Paul Rothi, irrigation manager; O. T. Reedy, engineer; J. R. Ummel, chief clerk.

Fort Laramie unit.—O. T. Reedy, construction engineer, Fort Laramie, Wyo.; H. W. Bashore, principal assistant engineer.

Belle Fourche project.—B. E. Hayden, project manager, Newell, S. Dak.; J. C. Counter, irrigation manager; J. H. Cuddy, chief clerk.

Strawberry Valley project.—J. L. Lytel, project manager, Provo, Utah; Ross Worsley, chief clerk.

Colorado River storage.—John T. Whistler, engineer, Denver, Colo.

DISTRIBUTION OF EMPLOYEES.

Employees, June, 1916.

Office or project.	Educational.	Non-educational.	Others.	Total United States.	Contractors.	Grand total.	
						Projects.	Division.
Washington office	95	....	10	105	....	105	
Denver office	61	2	....	63	....	63	
Field offices of chief counsel	35	....	....	35	....	35	
Billings office	2	....	....	2	....	2	205
Southern division:							
Salt River	21	130	260	411	....	411	
Yuma	15	72	200	287	....	287	
Rio Grande (distribution)	13	28	160	201	....	201	
Elephant Butte storage	11	35	185	231	....	231	
Carlsbad	3	14	130	147	4	151	
Hondo	....	1	5	6	1	7	
Lawton	1	2	1	4	....	4	1,292
Pacific division:							
Orland	4	11	20	35	....	35	
Boise (distribution)	29	115	240	384	....	384	
Boise (storage)	2	10	13	25	....	25	
Minidoka	11	105	200	316	....	316	
Jackson Lake enlargement	6	22	140	168	....	168	
Truckee-Carson	7	26	30	63	....	63	
Umatilla	9	20	150	179	....	179	
Klamath	5	46	266	317	14	331	
Yakima storage	11	47	604	662	....	662	
Sunnyside	7	29	29	65	....	65	
Tieton	3	15	12	30	....	30	2,258
Northern division:							
Blackfeet (Indian)	2	3	18	23	....	23	
Flathead (Indian)	15	37	57	109	78	187	
Fort Peck (Indian)	4	2	58	64	....	64	
Huntley	7	27	85	119	....	119	
Milk River	15	9	25	49	146	195	
St. Mary storage	9	25	137	171	....	171	
Sun River	20	34	121	175	110	285	
Lower Yellowstone	4	8	20	32	....	32	
North Dakota pumping	2	4	9	15	....	15	
Okanogan	4	7	35	46	....	46	
Shoshone	15	44	119	178	46	224	1,361
Central division:							
Grand Valley	13	30	169	212	60	272	
Uncompahgre	13	60	80	153	30	183	
North Platte (interstate)	9	76	68	153	3	156	
Fort Laramie	5	19	25	49	165	214	
Belle Fourche	8	21	45	74	15	89	
Strawberry Valley	8	18	20	46	....	46	
Colorado River storage	3	....	2	5	....	5	
Garden City	....	....	1	1	....	1	966
Grand total, June, 1916	507	1,154	3,749	5,410	672	6,082	6,082

Statement of injuries to employees of the United States Reclamation Service reported under the act of May 30, 1908.

Project.	Injuries reported.							Claims allowed.							Compensation paid.							
	1908-9[2]	1910	1911	1912	1913	1914	1915	1908-9[2]	1910	1911	1912	1913	1914	1915	1908-9[2]	1910	1911	1912	1913	1914	1915[3]	Total.
Salt River	23	9	9	7	13	12	15	16	9	6	6	8	4	11	$6,462.25	$4,397.01	$1,919.25	$798.00	$3,297.00	$1,340.75	$969.10	$19,183.36
Yuma	25	43	46	51	18	19	19	13	20	27	26	11	15	14	2,372.18	2,711.84	2,424.93	10,740.79	1,591.55	2,775.26	3,914.08	26,530.63
Orland	2	1	...	...	3	2	2	1	...	...	...	1	1	1	613.00	...	...	...	67.28	45.00	42.50	767.78
Klamath	8	...	2	4	...	3	2	6	...	...	2	...	2	1	1,456.81	...	306.48	172.63	...	147.00	96.46	2,179.38
Grand Valley	...	...	...	8	44	113	44	...	...	...	3	16	66	25	...	...	...	177.92	2,398.72	9,175.94	2,885.56	14,638.14
Uncompahgre	43	28	11	8	12	17	1	30	21	6	1	7	9	...	5,492.24	11,698.45	1,468.79	62.33	1,333.92	562.69	...	20,618.42
Minidoka	7	10	5	7	4	9	7	5	9	6	2	3	6	6	854.85	2,588.25	253.75	1,066.70	1,339.00	667.86	594.60	7,365.01
Boise	6	11	66	118	94	197	68	6	6	10	76	70	144	62	991.63	547.13	2,403.66	17,035.09	14,338.82	23,997.39	11,829.75	71,143.47
SnakeRiver storage	1	11	16	...	2	12	9	1	9	4	...	2	11	8	859.50	1,629.18	280.38	...	720.44	2,424.95	714.94	6,629.39
Garden City	3	...	...	...	...	...	...	1	...	...	...	...	...	...	77.46	...	...	...	...	...	...	77.46
Blackfeet (Indian)	1	4	1	2	3	8	...	1	4	...	1	2	2	...	282.50	1,417.90	...	52.20	195.85	252.96	...	2,201.41
Flathead (Indian)	8	4	19	9	9	5	2	1	2	7	5	4	2	1	110.50	555.25	1,541.38	481.11	366.91	118.12	30.00	44.16
Fort Peck (Indian)	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	44.16	...	3,203.27
Huntley	...	...	...	2	1	5	1	...	...	...	2	1	4	1	...	...	...	77.50	72.50	250.81	208.34	609.15
Milk River	6	5	...	3	6	14	3	5	2	...	1	1	9	2	721.10	581.77	...	47.10	39.60	888.08	83.80	2,361.45
St. Mary storage	...	1	2	4	7	7	29	...	1	2	...	6	4	7	...	49.87	316.58	...	445.43	956.83	447.00	2,215.71
Sun River	1	1	...	...	15	2	4	1	1	...	...	6	2	1	209.44	456.32	...	...	1,927.00	83.92	198.00	2,874.68
Lower Yellowstone	22	3	...	9	2	2	1	9	1	...	2	1	2	1	2,344.35	733.00	...	145.12	129.94	77.62	299.25	3,729.28
North Platte	4	7	10	12	11	7	5	3	4	8	5	10	4	3	320.28	1,071.60	2,676.66	2,829.16	1,453.08	1,137.78	172.70	9,661.26
Truckee-Carson	...	...	8	15	12	11	8	...	...	5	9	8	8	8	...	...	314.95	2,266.45	860.40	1,232.20	964.97	5,638.97
Carlsbad	...	...	...	1	...	...	4	...	...	...	1	...	...	2	...	...	...	33.00	...	...	642.41	675.41
Rio Grande	3	...	54	94	79	117	62	2	...	23	41	36	74	54	87.19	...	1,649.70	2,465.71	3,754.88	8,955.74	8,901.88	25,215.10
North Dakota pumping	8	5	2	...	7	6	1	2	2	1	...	...	2	1	229.99	123.51	601.21	...	...	101.86	39.00	1,095.57
Umatilla	...	...	...	...	...	4	14	...	...	...	...	...	1	1	...	...	...	...	...	78.00	81.60	159.60
Belle Fourche	3	1	3	1	4	1	4	1	1	3	...	...	1	3	790.40	208.00	192.36	...	...	40.32	330.53	1,561.61
Strawberry Valley	18	14	33	54	7	2	7	1	5	19	21	4	1	4	1,090.50	626.60	4,512.88	4,136.56	1,225.85	988.00	246.40	12,826.79
Okanogan	3	...	...	...	...	...	...	3	...	...	...	...	...	...	360.75	...	...	...	...	...	...	360.75
Yakima	35	36	39	28	41	47	70	16	9	13	9	22	18	27	3,284.10	2,013.77	3,773.77	750.88	2,031.23	1,876.82	3,019.45	16,750.02
Shoshone	3	8	2	17	20	12	9	3	2	2	12	8	10	6	304.75	134.35	140.40	3,685.85	611.59	589.79	499.89	5,966.62
	233	202	328	454	414	635	391	127	108	42	225	227	403	250	29,315.77	31,543.80	24,177.13	47,024.10	38,200.99	58,809.85	37,212.21	266,283.85

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[1] Payments do not include cost of hospital and medical service, or subsistence, or cost of employment of other persons in place of those injured.

[2] From Aug. 1, 1908, to Dec. 31, 1909.

[3] Payments not completed for injuries received in 1915.

ENGINEERING ARTICLES RELATING TO THE WORK OF THE SERVICE.

The following is a partial list of engineering articles relating to the work of the Reclamation Service as published in engineering and technical journals. The list is printed for the information of engineers and others interested in the work, and is a continuation of the list printed on pages 482 to 493 of the fourteenth annual report. Lists 1 and 2 are available for free distribution.

GENERAL ARTICLES.

Irrigation works: An informal discussion, Messrs. Mead, Ripley, Newell, Maxwell, Croes, Haupt, and Darrach, Trans. A. S. C. E., Dec., 1902, vol. 49, pp. 24–44.

The triumph of national irrigation (author of Conquest of arid America), with portraits, Messrs. Hitchcock, Newell, and Walcott, Wm. E. Smythe, Review of Reviews, July, 1904, vol. 30, p. 49.

Hearings illustrated, on irrigation, Hopson and Anderson, House committee, Eng. News, Feb. 18, 1909, vol. 61, p. 197.

Las Obras de Riego en los Estados Unidos de America, por D. Jose Nicolau y D. Narciso puig de la Bellacasa, Madrid, 1908, illus., 285 pages.

Area irrigated, 1908. Table. Eng. News, Feb. 18, 1909, vol. 61, p. 197.

Reclamation projects, state of completion, Feb., 1909 (table), Eng. News, Feb. 18, 1909, vol. 61, p. 197.

Constitutionality of reclamation act in United States circuit court (short news note), Eng. News, Feb. 18, 1909, vol. 61, p. 197.

Conservation of water by storage, Geo. F. Swain, Yale University Press, Mar., 1915 (illus. of Roosevelt Reservoir, Shoshone Dam, Pathfinder bedrock, Roosevelt Dam, Truckee Dam, Boise Tunnel (Arrowrock), Spring Canyon Flume, Yuma siphon (Roosevelt Dam Cons.). Review, Eng. Record, Aug. 7, 1915, vol. 72, p. 172.

The flow of water in irrigation channels, illus. and tables, Fred. C. Scobey, Dept. of Agri. Bulletin No. 194 (Salt River, Orland, Boise, and other projects). May, 1915.

American Association of Engineers (letters by F. H. Newell, and others), Mining & Sci. Press, Nov. 13, 1915, vol. 3, p. 731 (editorial, p. 728). The Great Problem.

Shall the irrigation settlers be given relief? (editorial) Eng. Record, Nov. 27, 1915, vol. 72, p. 650, and communication, p. 671.

Irrigation practice and engineering, Vol. II, Conveyance of water, B. A. Etcheverry, McGraw-Hill Book Co., N. Y. (illus. of Umatilla, Yakima, Tieton, Truckee-Carson, Boise, Uncompahgre Valley, Strawberry Valley, Belle Fourche, North Platte, also specifications for wood stave pipe, standard flumes, Umatilla Pipe Mfg. etc.), Nov., 1915.

Commission of scientists to study Panama slides (list of members appointed by President include A. P. Davis), Eng. News, Dec. 9, 1915, vol. 74, p. 1149.

Commission appointed to advise on Panama Canal slides, A. P. Davis, Eng. Record, Dec. 11, 1915, vol. 72, p. 742.

Total work of the U. S. R. S., C. J. Blanchard, June 30, 1915. Eng. Record, Dec. 11, 1915, vol. 72, p. 725.

Million acre-feet added to Reclamation Service storage capacity (statistics of construction to June 30, 1915), C. J. Blanchard, Eng. Record, Dec. 18, 1915, vol. 72, p. 772.

Rural credits necessary if irrigation enterprises are to succeed, Edward Gillette, Eng. Record, Dec. 25, 1915, vol. 72, p. 789.

Area and number of farms (short), Eng. Record, Dec. 25, 1915, vol. 72, p. 791.

Irrigation practice and engineering, vol. 2, by B. A. Etcheverry, reviewed by F. H. Newell, Eng. Record, Dec. 25, 1915, vol. 72, p. 796.

Commission to investigate canal slides (includes A. P. Davis), Eng. and Cont., Dec. 29, 1915, vol. 44, p. 500.

What the Engineering Society owes to its members, Address by F. H. Newell, Am. Asso. of Engrs., Eng. & Cont., Dec. 29, 1915, vol. 44, p. 497.

Tierras Aridas y Agua Fecundaute for E. Battle y Alvarez, u illus., Exportador Americano, Dec., 1915, vol. 77, p. 66 (by Johnson Export Pub. Co., 17 Battery Place, New York, N. Y.).

Why the U. S. should invest in farmers, illus., Elwood Mead, Irrigation Age, Dec., 1915, vol. 31, p. 21.

Dams and weirs, illus. with numerous photos and diagrams, by W. G. Bligh. Amer. Tech. Society, Chicago, Ill. (illus. and diagrams of Roosevelt, Arrowrock, Granite Reef, Pathfinder. Shoshone, Laguna, Corbett, and Automatic Dams), 1915, 206 pages.

Engineering as a career, F. H. Newell, editor, D. Von Nostrand Co. N. Y. (note of Eng. News, Jan. 20, 1916), vol. 75, p. 123.

Irrigation in the United States, by R. P. Peele, review by F. H. Newell, Eng. Record, Jan. 22, 1916, vol. 73, p. 120. (See also Eng. Record, July, 20, 1916, p. 118.)

Brief biography of S. B. Williamson, Eng. Record, Jan. 22, 1916, vol. 73, p. 132.

Masonry dams (3-page extract from paper Intn. Eng. Cong.), Arthur P. Davis and D. C. Henny, Canadian Engineer, Jan. 27, 1916, vol. 30, p. 186.

National Drainage Congress (6th meeting, Cairo, Ill.), address by F. H. Newell, Eng. News, Jan. 27, 1916, vol. 75, p. 195.

Brief biography of F. E. Weymouth, Eng. Record, Feb. 12, 1916, vol 73, p. 234.

Earth roads on light soils, by A. P. Anderson in Reclamation Record), Western Engineering, Feb. 1916, vol. 7, p. 64.

Engineering reference library (U. S. R. S. library), W. I. Swanton, Pac. Builder and Engineer, Feb. 1916, vol. 21, p. 91.

Classification of expenditures for irrigation work, by F. H. Newell, Eng. & Cont., Mar. 1, 1916, vol. 45, p. 201.

Making the desert bloom, how the U. S. Reclamation Service is developing our waste regions, illus., C. J. Blanchard, Sci. Amer., Mar. 4, 1916, vol. 114, p. 242.

Does alkali disintegrate concrete? by E. C. Bebb (from February Reclamation Record), Eng. Record, March 4, 1916, vol. 73, p. 316.

Economic preparedness, our natural resources and how they are being developed, Franklin K. Lane, Sci. Amer., Mar. 4, 1916, vol. 114, p. 237.

Some costs of applying mortar with cement gun, E. C. Bebb, Eng. News, Mar. 9, 1916, vol. 75, p. 469.

Map of the West shows activities of the Interior Dept. (½ col. news item), J. F Pellen, Eng. Record, Mar. 11, 1916, vol. 73, p. 374.

Effect of alkali on concrete, by E. C. Bebb (from Feb. Reclamation Record), F & Cont., March 15, 1916, vol. 45, p. 257.

Reclamation Service siphons, illus., with costs (staff article on Belle Fourch River, and Salt River projects), Eng. & Cont., Mar. 15, 1916, vol. 45, p. 248.

Back of dam coated by cement gun from raft as pool rises (from Reclamation March), E. C. Bebb, Eng. Record, Mar. 18, 1916, vol. 73, p. 400.

Engineering as a career (Review of book by F. H. Newell, by editor), E April 1, 1916, vol. 73, p. 458.

Engineering as a career, F. H. Newell, editorial review of book, Eng. N 1916, vol. 75, p. 749 (also notice of Irrigation manangement, by F. H. N

Irrigation practice and engineering, Vol. III (B. A. Etcheverry, r Newell), Eng. Record, Apr. 22, 1916, vol. 73, p. 555.

Power possibilities of Federal irrigation projects, A. P. Davis, E 1916, vol. 75, p. 875.

Theory of dam design, review of dams and weirs, W. G. Bligh, b News, June 15, 1916, vol. 75, p. 1134.

Water conservation by storage, Geo. F. Swain (review of, b News, June 15, 1916, vol. 75, p. 1131.

Our great irrigation works, a review of "Irrigation and A. D. Lewis, author, N. S. R. S. projects, Eng. News, Jun

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Scathing arraignment of Reclamation Service agitati Review, Eng. Record, July 15, 1916, vol. 74, pp. 66, 67

Report of International Eng. Cong. 1915, issued in and includes papers by F. H. Newell, A. P. Dav L. C. Hill, and others. Eng. News, July 20, 1916,

Irrigation management: The operation, mainte bringing water to agricultural lands, F. H. Newe p. 118.

U. S. R. S. project manager's duties defined, D. W. Cole (July, 1916, Reclamation Record); Eng. Record, July 22, 1916, vol. 74, p. 108.

Power development possibilities of completed Reclamation Service projects, A. P. Davis, Engineering & Contracting, Aug. 9, 1916, vol. 46, p. 139.

Curves for irrigation-ditch velocity and discharge, letter by Julian Hinds, with diagram, Eng. News, Aug. 24, 1916, vol. 76, p. 369.

Bronze-on-bronze friction in sluice gates tested, D. C. Henny, Eng. Record, Sept. 9, 1916, vol. 74, p. 330; letter regarding same, Sept. 30, 1916, p. 420.

Amend reclamation extension act (short), Eng. Record, Sept. 23, 1916, vol. 74, p. 394.

How crop statistics in irrigation are gathered, Jour. of Elec. Power & Gas, Oct. 14, 1916, vol. 37, p. 305.

Masonry dam, design, including high masonry dams (includ. Arrowrock, Elephant Butte, Pathfinder, Roosevelt and Shoshone Dams, Chas. E. Morrison and O. L. Brodie, 1st ed.), 1916, John Wiley & Sons, N. Y., 276 pages.

Typhoid inoculation in the Reclamation Service, by Hugh Arbuthnot Brown, M. D., reprinted from International Clinics, Vol. II, series 26, 1916.

ARIZONA, SALT RIVER PROJECT.

Highly erratic stream flow utilized efficiently, illus. (Cross-Cut power plant), O. H. Ensign, Eng. Record, Jan. 1, 1916, vol. 73, p. 19.

Hydroelectric irrigation in Arizona (inclu. costs), illus., O. H. Ensign, Jour. of Elec. Power and Gas, Feb. 5, 1916, vol. 36, p. 105.

Following the Apache Trail, illus. (popular account of auto trip via Roosevelt Dam), Wendell P. Colton, Literary Digest Advertiser, Feb. 5, 1916, p. 294.

Five miles of Roosevelt Road washed out by January floods, illus. (from March Reclamation Record), Wm. S. Cone, Eng. Record, Mar. 4, 1916, vol. 73, p. 336.

Venturi meter developed for accurate measurement of irrigation water, illus., Alan A. Wood, Eng. Record, Mar. 25, 1916, vol. 73, p. 411.

Impulse water wheels developed for silt-laden water (long illustrated article), J. W. Swaren, Eng. News, Apr. 20, 1916, vol. 75, p. 740 (also editorial p. 762, Power under difficulties); also letters "Credit for novel power plant;" Eng. News, June 22, 1916, vol. 75, p. 1199, and Cross cut power sta., Eng. News, July 13, 1916, vol. 76, p. 86.

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Eight plate girder spans over Gila River washed out (floods), illus., Eng. News, Apr. 27, 1916, vol. 75, p. 792.

Flood conditions in the desert, illus., Wm. S. Cone, Eng. News, May 11, 1916, vol. 75, p. 873.

Failure of (power canal) diversion dam on Salt River project, illus. (from reports of L. C. Hill and W. S. Cone), Eng. News, May 25, 1916, vol. 75, p. 974.

Venturi meter succeeds in irrigation, illus. (Salt River project), Eng. News, June 15, 1916, vol. 75, p. 1122.

Phoenix, Ariz., to enlarge (Maricopa) Canal (Salt River Valley Canal to be eliminated), Eng. Record, June 17, 1916, vol. 73, p. 813.

Canal cleaning by sheep and goats past experimental stage (with cost data), A. J. Halton, Eng. Record, June 24, 1916, vol. 73, p. 840.

Water evaporation studies by Weather Bureau (illus. of Roosevelt Evap. Sta.), Messrs. Kadel and Abbe, Eng. News, Aug. 3, 1916, vol. 76, p. 200.

Pumping water from wells on the Salt River project, W. S. Cone, Eng. & Cont., Aug. 9, 1916, vol. 46, p. 124.

Mowing by machine at an angle of 45° (short article), A. J. Haltom, Eng. News, Aug. 24, 1916, vol. 76, p. 364.

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Imperial Valley and Salton Sink, illus., H. T. Cory (John J. Newbegin, Pub., San Francisco, Cal., description, sci. facts, watershed, developments, population, etc., inclu. Cory's paper Irrigation and river control, with full description Yuma project), Dec., 1915.

Solving the Imperial Valley irrigation problems (editorial), Eng. News, Jan. 27, 1916, vol. 75, p. 170.

Colorado River at 34-foot stage inundates Yuma, L. M. Lawson, Eng. Record, Jan. 29, 1916, vol. 73, p. 159.

p. 246.

Study silt problem in Imperial Valley system, J. C. Allison, Eng. Record, Feb. 5, 1916, vol. 73, p. 182.

Seven hundred-foot bridge in Arizona left high and dry by floods (illus., U. S. R. S., Indian Reservation lands flooded), L. M. Lawson, Eng. Record, Feb. 5, 1916, vol. 73, p. 192.

Colorado River attains highest stage on record (208,000 sec. ft.), news article Eng. Record, Feb. 12, 1916, vol. 73, p. 220.

The Yuma Valley R. R. (L. M. Lawson in Reclamation Record), Western Engineer ing, Feb., 1916, vol. 7, p. 72.

Irrigation laws developed in Cal. (ref. to Imperial Valley and Iron Canyon proj and tables of areas, and costs), Eng. Record, Apr. 15, 1916, vol. 73, p. 510.

Estimates to be made for Yuma irrigation project (Mesa pumping unit) (news note), L. M. Lawson, Eng. Record, Apr. 29, 1916, vol. 73, p. 595.

Novel hydraulic-fill temporary diversion dam construction, Colorado River (rial heading), illus., Eng. & Cont., June 7, 1916, vol. 45, p. 514.

Build dam across the Colorado River in seven days (Handlon heading), Eng. Aug. 12, 1916, vol. 74, p. 215. Must remove by Nov. 1, p. 303.

Colorado River conditions this year unprecedented, L. M. Lawson, Eng. Sept. 16, 1916, vol. 74, p. 346.

Temporary rock-fill dam on Colorado River, Eng. News, Sept. 28, 191 p. 622.

Solve silt problem on Yuma irrigation project, L. M. Lawson, Eng. R 30, 1916, vol. 74, p. 406.

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Methods and cost of concrete lining irrigation laterals, Orland projec Eng. & Cont., Apr. 12, 1916, vol. 45, p. 352.

Methods of placing and cost of concrete canal lining, A. N. Burch Apr. 15, 1916, vol. 23, p. 38.

Gives cost of concrete lining laterals on average job, A. N. Bu June 3, 1916, vol. 73, p. 747.

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